

THE TROMBICULINAE (ACARINA) OR ITCH-MITES OF THE
AUSTRO-MALAYAN AND ORIENTAL REGIONS

By H. WOMERSLEY, A.L.S., F.R.E.S., South Australian Museum,
and W. G. HEASLIP, M.B., B.S.*

PLATES II-XIII, TEXT FIG. 1-18

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INTRODUCTION

The economic importance of this group of mites lies in the fact that, as larvae, they are external parasites of vertebrates, including man, and that in the above regions certain species have been incriminated as the vectors of the form of typhus, commonly known as "tsutsugamushi" fever, from the primary hosts, rodents and small marsupials, to man. This disease occurs throughout the area covered in this study.

The adults, of which few species are known, are small, eight-legged, white to cream or reddish creatures, usually elongate, with a medial constriction giving them the shape of a figure 8. They are clothed with a dense mat of ciliated hairs, from which the popular name of "velvet mites" is derived.

Little is known of the feeding habits of the nymphs or adults, but they are probably vegetarian. They may be found under stones, in the soil, or under logs amongst the herbage in damp gullies, etc.

The eggs of the genus *Trombicula* s. str., as far as is known, are laid in clusters in the soil or other habitat favoured by the adult. The genus *Guntherana* is remarkable in that the eggs are found attached to the hairs of the host, a fact which suggests that the adult, for a time at least, lives in the fur of the hosts. The larvae are small microscopic six-legged creatures which, in the case of some genera at least, lurk or move amongst the herbage until they are able to attach themselves to a passing host. On the hosts they are frequently to be found in colonies in the ears, in the axillae or on the genitalia.

These mites have for long been known in many parts of the world as the cause of intense irritation to workers in the fields at harvest time, and to workers in the scrub of tropical and subtropical parts. In Europe, America and Australia they are popularly known as "harvest mites," and in America as "chiggers"; in Surinam as "batatas" or "bête rouge"; in Mexico as "tlasahuate"; in Japan and Formosa as "akamushi" or "kedani"; as "itch mites" or "ti-tree itch" in Australia and as "scrub itch" in Malaya and New Guinea.

The first mention in scientific literature of these mites was in 1758 when Linnaeus described the "bête rouge" of Surinam under the name of "*Acarus batatus*." Sambon, L. W., 1928, *Annals of Trop. Medicine and Parasitology*, 22, 67, states that the association between mites and the disease has been known for over 1,000 years. Palm, Th. A., 1878, described the disease in the Edinburgh Med. Journal, 24, 128. In 1879 Baetz, E., and Kawakami, *Archiv. für Path. Anat. und Physiologie, und für Klin. Med. (Virchow's Archiv.)*, 78, 373) recognised the suspected vector as a larval mite resembling *Leptus autumnalis* but discounted its importance. Tanaka, 1899, attributed the "tsutsugamushibo" or "river fever" of Japan to a minute red mite locally called "Kedani" (hairy mite), and in this connection figured three larval mites, but none of the figures correspond with Brumpt's *T. akamushi* (1910), a species which occurred on field mice in Japan and attacked man as well as domestic animals. The matter was followed up by other Japanese workers and it is now definitely accepted, both in Japan and

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Formosa, that this mite is the vector in the transmission of the disease. In 1924 Walch and Keukenschrijver showed that another species, *T. deliensis*, was probably the vector of a "tsutsugamushi"-like fever in Sumatra, the primary hosts being various species of *Rattus*. Later, 1928, Fletcher, Lesslar and Lewthwaite suggested a similar larval Trombid mite as the vector of tsutsugamushi as well as of "tropical typhus" in the Federated Malay States, and, in 1932, Gater made a survey of the Trombidiid larvae of the Federated Malay States and of their primary hosts. Fletcher, 1928, showed that *T. deliensis* Walch, and its Sumatran hosts were present in the Federated Malay States. Gater also added *T. akamushi* (Brumpt), *T. hirsti* Sambon and *T. acuscutellaris* Walch as being found on man. In the present paper the first of these is shown not to be the Japanese form but a new species (*T. fletcheri*). In New Guinea C. Gunther, 1938-1940, has investigated the "endemic typhus" of that region and incriminated a species of mite, which he called *T. hirsti* v. *buloloensis*, as the probable vector. He also found *T. deliensis* (= *vanderghinstei* Gunther) on rats, but not so plentifully. Mehta (1937) records *T. deliensis* as associated with scrub typhus in the Simla Hills, India.

In 1927 Sambon described from Innisfail, Queensland, a "scrub itch mite" under the name of *T. hirsti* from human beings; a species which Walch thought synonymous with *T. pseudoakamushi* Hatori 1919. This has now been shown to be the same as *T. minor* Berl. Heaslip, 1939-41, in investigating the typhus-like fevers of Queensland, has found *T. deliensis* to be the probable vector of K-typhus. He also found that *T. hirsti* was not present amongst some 2,500 larval mites collected from the natural animal reservoirs. The rats from which the North Queensland material was collected were identified and comprised seven species, viz., *Rattus conatus* Thomas 1923, *R. rattus* (Linn. 1758), *R. assimilis* (Gould. 1858), *R. norvegicus* (Erxleben 1777), *Uromys littoralis* Lonnberg 1916, *Hydromys chrysogaster reginae* Thomas and Dollman 1908 and *Uromys caudimaculatus* Krefft 1867. As each species of rat harboured many species of mite, and no species of mite showed any definite preference for any one species of host, the specific species of rat from which the individual species of mite were collected have not been detailed.

While species of *Eutrombicula*, *Schöngastia*, *Neoschöngastia* and *Lecanvenhoekia* are also known to bite humans, it is only with species of *Trombicula* s. str. that we can as yet connect the occurrence of disease. Nevertheless, to completely understand and appreciate the importance of these mites to mankind it is highly desirable to know all we can of their life-history, and also to be able to identify the known larval forms and link them up with their respective adults when discovered. This work should be carried out by well designed and checked breeding experiments. Most such experiments so far have endeavoured to rear the nymphs and adults from larvae. Apart from the difficulty of satisfactorily identifying the larvae in life (the specific identification requires high-power microscopy), most workers have used a number of specimens in a tube, ignoring the fact that rarely does a colony on a host consist of a single species.

The only satisfactory procedure is to start with the gravid female and hatch out the larvae; in this way the female is also available after oviposition for microscopic examination.

Of the 19 genera of Trombiculinae recognised as valid in the present paper only *Blankaartia* Oudem. and *Trombicula* Berl. are definitely known from the adults or nymphs as well as larvae, all the others being larval genera only.

In addition to the new species described, *Neoschöngastia novae-hollandiae* (Hirst) and *Neoschöngastia perameles* Wom. are now recorded for the first time from North Queensland.

The most important specific characters are to be found, firstly, in the shape and dimensions of the dorsal scutum and its attendant setae, both normal and

sensillary, and secondly in the number and arrangement of the dorsal setae. Other workers have tried to find specific differences in the number and nature of the setae on the tarsus of the palp, and in the bi- or trifurcation of the palpal claw. These latter characters, however, are sometimes difficult to see clearly, while it is doubtful whether the arrangement of the setae is of more than generic value. On the other hand, in well mounted specimens, the characters of the dorsal scutum and the dorsal setae are comparatively easy to determine. The actual size of the whole creature is of very little importance and largely depends upon whether it has fed or not. Generally it is easier to make out the arrangement of dorsal setae from a fully gorged specimen. On the ventral surface the setal pattern of the coxae is of some value but the arrangement of setae behind the third pair of coxae is usually more irregular and less important than on the dorsum.

The chaetotaxy of the legs is generally fairly uniform and offers little variation of specific value within a genus.

For critical identification high power magnification is essential, as stated above, and to ensure this proper clearing and mounting of the specimens is necessary. In the first place, only a single specimen should be mounted on a slide, even from what appears to be a colony of the same kind, for only rarely can a single species be found on one host. For examination and drawing, a specimen is temporarily mounted straight from alcohol into a drop of glacial lactic acid on a slide and covered with a cover glass. The mount is then gently heated over a spirit lamp until it just bubbles. This ensures perfect clearing and details of both dorsal and ventral surfaces can usually be readily seen and drawn or measured. For a permanent mount, the cover glass is carefully lifted off and the specimen transferred to a drop of gum-choral⁽¹⁾ on another slide, covered and heated as for the temporary mount.

The careful measuring of a standard series of data from the scutum⁽²⁾ of the different species and a comparison of the arrangements of the dorsal setae have shown that these can be used to distinguish specifically the many species of larvae. The various dimensions used are indicated by abbreviations, and quoted in microns in a definite order as follows:

AW	=	width between the bases of the antero-lateral scutal setae.
PW	=	width between the bases of the postero-lateral scutal setae. ⁽³⁾
SB	=	distance between centres of sensillae bases.
ASB	=	distance from anterior margin to sensillae bases.
PSB	=	distance from posterior margin to sensillae bases.
A-P	=	distance between antero-lateral and postero-lateral setae.
AM ⁽⁴⁾	=	length of antero-median setae.
AL ⁽⁴⁾	=	length of antero-lateral setae.
PL ⁽⁴⁾	=	length of postero-lateral setae.
Sens.	=	length of sensillary setae.
DS	=	length of dorsal setae.
SD	=	depth of scutum = ASB + PSB.

⁽¹⁾ With the older formulae for gum-chloral, experience shows that in course of time considerable crystallisation takes place and renders the mounts opaque. This is apparently due to the loss of acetic acid, and in the medium now recommended this is replaced by the less volatile and more viscous glacial lactic acid.

⁽²⁾ The figures of the scuta given in this paper are all drawn to scale from standard data and to magnification of 500 diam.

⁽³⁾ It is to be noted that PW as used here is always slightly less than the greatest width as used by earlier workers.

⁽⁴⁾ In the genus *Leutenhockia* there are two AM of equal length; in *Walchia* and *Gahrlicpia* AM is entirely wanting. In *Trombiculoides* AL setae are triplicated and the most posterior pair is regarded as the PL, but in *Gahrlicpia* the first pair behind the sensillae bases is the PL, any posterior of these being members of the DS embraced by the backwardly extended scutum.

The arrangement of dorsal setae is usually constant and easily discernible, at least in the anterior rows. The setae in each row are quoted in order of rows from front to back, making due allowance for curvature of the rows.

While within the larval species, as here recognised, the measurements of the standard data appear to give sound differentiation of the species, there does, in some, at least where a good number of specimens have been measured, appear to be a rather wide though limited range of variation of any one character. It would therefore be worth while, when sufficient material is available, to treat the measurements statistically with a view to verifying the validity of each species.

The DS are normally in rows, generally transverse, and often anteriorly curved. Usually the first or anterior row consists of two setae, one on each side of the scutum; it may occasionally consist of none or four setae.

The total number of species recognised in this paper is 92, together with 4 varieties, as follows:

<i>Trombicula</i> - - 30 and 1 variety	<i>Paraschöngastia</i> - 5 and 1 variety
<i>Myotrombicula</i> - 1	<i>Guntherana</i> - - 1
<i>Trombiculoides</i> - 1	<i>Walchia</i> - - 6
<i>Schöngastia</i> - 7 and 1 variety	<i>Gahrleipia</i> - - 6
<i>Neoschöngastia</i> - 34 and 1 variety	<i>Lceutenhoekia</i> - 1

Lastly, this paper has largely been rendered possible and its value increased by the generous help of colleagues from elsewhere than Australia. To the following we are particularly indebted and desire to express our sincere thanks. From Prof. Dr. M. Takenouchi of the Institute of Bacteriology, Imperial University of Tokyo, we have received authentic material of Japanese species. From Prof. J. E. Dinger, Director, Konigin Wilhelmina Institute, Batavia, Java, we have received specimens of certain of Walch's species. Valuable preparations of some of Gater's species have also been forwarded by Mr. Hodgkin from the Institute for Medical Research, Kuala Lumpur, through the kindness of Lieut.-Col. B. A. R. Gater and Dr. R. Lewthwaite. In addition Mrs. Dr. Walch, of Samarang, graciously forwarded reprints of some of her late husband's papers.

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SYSTEMATICS

KEY TO THE GENERA OF LARVAL TROMBICULINAE

- 1 With two median dorsal scuta. Eyes two on each side, anterior larger than posterior. Numerous small platelets behind second dorsal scutum. Tarsi I and II with two, III with three claws. 2
Gen. *Blankaartia* Oudms. 1911
- With only one median dorsal scutum. All tarsi with three claws. —
- 2 Anterior margin of dorsal scutum with one median or two medial setae. 5
 Anterior margin of dorsal scutum without median or medial setae. 3
- 3 Tarsi with two unequal claws. Sensillae simple. Setae on legs and dorsum simple. 3
Gen. *Hemitrombicula* Ewing 1938
- Tarsi with three claws. Sensillae clavate or capitate. 4
- 4 Dorsal scutum with only four setae, antero- and postero-lateral. A-P = or $> \frac{1}{2}$ SD. Sensillae clavate. 4
Gen. *Walchia* Ewing 1931

- Dorsal scutum with four or more setae, due to posterior prolongation of scutum to take in two or more of the median setae of one or more of the dorsal rows; A-P always $< \frac{1}{2}$ SD. Sensillae globose or clavate. Gen. *Gahrlicpia* Oudms. 1912
incl. *Schöngastrella* Hirst 1915
incl. *Gateria* Ewing 1938
- 5 With two medial setae on anterior margin of dorsal scutum. 6
With one median seta on anterior margin of dorsal scutum. 8
- 6 Scutum longer than wide, lateral margin produced well in front of AL, apex truncate. Traces of crista present. Sensillae filamentous. Coxae I with two, II and III with one seta; none between coxae I Gen. *Heterotrombidium* Verd. 1909
Lateral margins of scutum not produced in front of AL. Scutum wider than long. 7
- 7 Anterior margin of scutum with a median forwardly directed process. Coxae I with two, II and III with one seta; no setae between coxae I. Chelicerae serrate. Sensillae filamentous. Gen. *Leutechnoekia* Oudms. 1911
Anterior margin of scutum without above process; otherwise similar. Gen. *Hannemannia* Oudms. 1911
- 8 Mandibles and palpi modified for grasping hair. Sensillae lost, probably filamentous. On bats. Gen. *Myotrombicula* nov. 9
Mandibles and palpi normal. 9
- 9 Sensillae filamentous, with more or less distinct ciliations. 10
Sensillae globose, clavate or lanceolate, nude or ciliated. 14
- 10 With nine scutal setae in addition to sensillae. Scutum broader than long, without posterior angles, evenly rounded from anterior angles. Chelicerae with a very large inner subapical tooth. Gen. *Trombiculoides* nov. 11
With five scutal setae in addition to sensillae. 11
- 11 AL or AL and AM scutal setae stout and spine-like. Gen. *Fonsecia*, Radford 1942 12
The above setae normal. 12
- 12 Chelicerae not serrate dorsally, with a single apical tooth; ventral tooth always present. 13
Chelicerae with three equal or subequal dorsal teeth. Dorsal scutum well developed Gen. *Odontacarus* Ewing 1929
= *Endotrombicula* Ewing 1931
- 13 Palpal claw trifurcate. Dorsal setae > 30 . Gen. *Trombicula* Berlese 1905
inc. *Pentagonella* Sig. Thor. 1936
Palpal claw bifurcate. Dorsal setae < 30 . Gen. *Eutrombicula* Ewing 1938
- 14 All coxae multisetose. Scutum roughly triangular with apex directed forwards. Gen. *Dolopsis* Oudms. 1910
Coxae I and II always unisetose, III sometimes multisetose. Scutum trapezoidal, pentagonal or hexagonal. 15
- 15 Middle claw thickest and distally lanceolate. Eyes absent? All coxae unisetose. Sensillae globose. Gen. *Reidlinca* Oudms. 1916
Middle claw not lanceolate. 16
- 16 Body definitely constricted medially. Dorsally with a rounded caudal plate, generally longitudinally divided and bearing three pairs of fine setae. Gen. *Guntherana* n.n.
for *Guntheria* Wom. 1936 preocc. 17
Body not so. No caudal plate. 17
- 17 Chelicerae serrate. Sensillae globose or clavate. Gen. *Schöngastia* Oudms. 1910
Chelicerae not serrate, with only a single small subapical tooth. 18
- 18 Scutum with a raised transverse crest forming a wall in which the sensillae arise. Coxae III with one, two or three setae. Sensillae globose. Gen. *Paraschöngastia* Wom. 1939
Scutum without above crest. Coxae rarely with two to four setae. Sensillae globose, clavate or lanceolate. Gen. *Neoschöngastia* Ewing 1929

Genus TROMBICULA Berlese 1905

Acari Nuovi, Manipl. IV, p. 155, in Redia II, fasc. 2, 1905. Genotype *T. minor* Berl. 1905, *loc. cit.*

Although this name was first used in 1905 for *Trombicula minor* from Java, Berlese does not appear to have given a generic description until the publication in 1912 of his monograph on the Trombidiidae in Redia VIII, fasc. 1, p. 83. The two specimens described by Berlese are now generally considered to be nymphs and to be the same as *T. mediocris* Berlese 1912, also described from Java as the adult.

The larval form of this genus was unknown until 1916, when Japanese workers, Miyajima and Okumara, and Nagayo and his co-workers established by breeding that the larval species *Trombidium akamushi* Brumpt developed into a *Trombicula*-like nymph and adult, very closely resembling *T. minor* Berl. In this paper 30 larval species of *Trombicula* s. str. are recognised from the Austro-Malayan and Oriental Regions, together with a variety of one of them.

The genus can be characterised as follows:

Adult and nymph: shaped like a figure 8, white to reddish in colour, with clothing of close ciliated setae. Crista present with posterior sensory area and a pair of long filamentous sensory setae. Eyes 1 + 1, closely adjacent to sensillary area, or none. Larvae: with a single anterior dorsal scutum with five normal setae and two sensory setae which are long and filamentous and ciliated or not; chelicerae not serrate dorsally, with a single apical tooth and a ventral tooth. Palpal claw trifurcate.

KEY TO THE SPECIES OF LARVAL TROMBICULA OF THE AUSTRO-MALAYAN AND ORIENTAL REGIONS.⁽⁵⁾

- | | | |
|---|--|---|
| 1 | Scutum almost rectangular, with well-defined posterior angles. PL about midway between anterior and posterior angles. | 2 |
| | Not entirely as above. | 3 |
| 2 | Anterior and posterior margins of scutum rectilinear. Scutal setae tapering to a point. AM 48, AL 44, PL 50, AW 64, PW 50, A-P 20, SD 38, DS 2.12.4.10.4.8.8.4. (After Walch.) <i>T. keukenschrijveri</i> Walch 1923 | |
| | Anterior margin of scutum sinuous; posterior margin making a very slight obtuse medial angle. Scutal setae stout, bushy and apically blunt. AM 44, AL 40, PL 50, AW 60, PW 66, A-P 18, SD 38, DS 2.12.14.12.10.8.6.4.2. <i>T. pallida</i> Nagayo et al. 1919 | |
| 3 | AW greater than 45. | 5 |
| | AW less than 40. | 4 |
| 4 | Sensillae with only two or three cilia on each side in apical half. AW 33, PW 47, A-P 17, DS 2.6.6.4.4.2. <i>T. munda</i> Gater 1932 | |
| | Sensillae with numerous cilia on apical half. AW 38, PW 51, A-P 20, DS 2.6.4.4.4.4.2. <i>T. spicca</i> Gater 1932 | |
| 5 | Scutum roughly pentagonal. Tarsus III with long sensory seta. | 6 |
| | Scutum not pentagonal. | 7 |
| 6 | AW and PW about equal. PL much longer than AM or AL. AW 75, PW 80, A-P 27, Sens. 78, DS 2.6.6.6(4).4(2).2(0). <i>T. acuscutellaris</i> Walch 1923 | |
| | AW less than PW. PL not much longer than AM or AL. AW 80, PW 97, A-P 33, Sens. 92, DS 2.8.6(8).6(8).4.4.6 (probably 2.8.6.6.4.4.2). <i>T. japonica</i> (Tanaka 1916) | |
| 7 | AW much less than PW, so that anterior angles of scutum are widely obtuse. AW 60, PW 87, A-P 19, SD 39, Sens. in line of PL, DS 2.8.6.6.4.2. <i>T. quadriense</i> n. sp. | |
| | AW not much less than PW. Anterior angles of scutum not or only slightly obtuse. | 8 |

⁽⁵⁾ Excluding *T. cereulicala* Ewing 1931, from India.

- 8 Scutum practically rectangular and posterior margin almost rectilinear between PL. Sens. near to posterior margin of scutum. AW 72, PW 78, A-P 38, DS. 2.8.9.12.11.6.4.4.2. (After Walch.) *T. densipiliata* Walch
Scutum not rectangular. Posterior margin more or less curved. 9
- 9 Scutum relatively small, less than $3,000 \mu^2$; posterior margin extending not more than 12μ behind line of PL. 10
Scutum relatively larger, more than $4,000 \mu^2$; posterior margin extending more than 15μ behind line of PL. 21
- 10 Posterior margin of scutum an even shallow curve. 11
Posterior margin of scutum not an even curve. 13
- 11 Scutum rugose. AW 47, PW 69, SB 14.5, SD 34, A-P 21, AM 27, AL 27, PL 43, Sens. 51, DS 2.8.6.6.4.2. *T. chiroptera* n. sp.
Scutum smooth. 12
- 12 AW 60, PW 65, A-P 26, SD 40, DS 2.8.8.8.6.4.2. (After Hirst).
T. gliricolens (Hirst 1915)
AW 57, PW 67, A-P 28, SD 39, DS 2.8.6.6.4.2. *T. walchi* sp. no.
AW 49, PW 59, A-P 22, SD 42, DS 2.6.6.6.4.2. (After Sugimoto.)
T. issikii Sugimoto 1938
- 13 Posterior margin of scutum shallow, extending only slightly behind line of PL, almost straight. 14
Posterior margin of scutum deeper, extending more than 10μ behind PL. 17
- 14 AM longer than AL or PL. AW 58, PW 69, A-P 30, DS 2.8.6.8(10).8.4.2.
T. akamushi Brumpt 1910
AM shorter than PL. 15
- 15 Sensillae anterior of line of PL. 16
Sensillae in line of PL. DS 2.12.8.8.4.2. AW 73, PW 82, SB 27, SD 38, A-P 28, AM 25, AL 28, PL 47, Sens. 41. (After Gunther 1941.) *T. robusta* Gunther 1941
- 16 DS 2.8.6.6.6.4. AW 56, PW 64, A-P 27. *T. bodensis* Gunther 1940
DS 2.10.8.6.4.2. AW 62, PW 75, A-P 26. *T. fletcheri* n. sp.
- 17 DS 2.8.6.6.4.2. AW 63, PW 77, A-P 28, AL 44, PL 63. *T. deliensis* Walch 1924
= *vanderghinstei* Gunther 1940
DS 2.10.+ 18
- 18 A-P greater than half SD. 19
A-P less than half SD. 20
- 19 Sens. 58, ciliated only on basal half. PW 85, SD 37, Sens. 8 in advance of line of PL. DS 2.10.10.16.12.10.8 and 45μ long. Eyes 1 + 1. On birds.
T. corvi Kaw. and Yam. 1921
Sens. 70, ciliated to tip, bases in line with or slightly behind line of PL. AW 57, PW 69, A-P 26, AM 51, AL 43, PL 53, SD 43, DS 2.10.10(12).10(8).6.4.
T. scutellaris Nagayo et al. 1920
- 20 Sensillae bases well behind line of PL. DS 2.10.10.+ AW 60, PW 66, A-P 17, SD 37, AM 45, AL 37, PL 48, Sens. 56. *T. palpalis* Nagayo 1919
Sensillae bases only slightly behind PL. DS 2.10.8.8.6.4.2. AW 53, PW 60, A-P 18, SD 36, AM 53, AL 41, PL 57, Sens. 65 (After Nagayo) *T. intermedia* Nagayo 1920
- 21 Sensillae well in advance of midline of scutum, much nearer line of AL than PL. Scutum almost as deep as wide, 75μ by 100μ . AM 40, AL 33, PL 40, SD 74, AW 85, PW 100, A-P 40, DS 2.4.4.4.2. (in text) 2.6.2.4.4.2. (in figure). (After Walch.)
T. rara Walch
- Sensillae much nearer to line PL than AL. 22
- 22 Posterior margin of scutum sinuous or flattened medially. 23
Posterior margin of scutum an even curve. 27
- 23 AW/AP greater than 3. Scutal setae parallel-sided almost to tip, serrated rather than ciliated. DS 2.14.16.12.+ AW 100, PW 110, A-P 31, SD 63. *T. rioi* Gunther
AW/AP less than 3. Scutal setae tapering and ciliated. DS 2.6.+ 24
- 24 Sens. in midline of scutum, i.e., ASB = PSB. 25
Sens. anterior to midline of scutum, i.e., ASB < PSB. 26

- 25 AW 79, PW 92.5, A-P 31.5, AM 43, AL 46.5, PL 58, Sens. 63, DS 2.6.6.4.2.2.
Posterior margin of scutum medially flattened or slightly sinuate.
T. wichmanni Oudms, 1905
AW 72, PW 85, A-P 27, AM 36, AL 36, PL 50, Sens. 55, DS 2.6.6.4.2. Posterior
T. hatorii n. sp.
= *pseudoakamushi* Kaw. and Yam.
- 26 AW 75, PW 86, SB 41, ASB 24, PSB 35, A-P 35, AM 42, AL 46, PL 52.
T. minor Berlese 1904
= *hirsti* Sambon 1927
AW 84.5, PW 99.5, SB 44.5, ASB 26.5, PSB 38.5, A-P 34.5, AM 48, AL 53, PL 58.5.
T. minor v. *deliensis* Walch 1923
= *hirsti* v. *buloloensis* Gunther 1939
- 27 Sensillae slightly behind PL, about 95 long. AW 71, PW 96.5, A-P 35, SD 62, DS 2.6.6.6.6.4.2.
T. novae-hollandiae Hirst
- 28 Sensillae in front of PL, 65-70 long. 28
Sens. with only three branches. DS 2.6.6.6.4.2., AW 78.5, PW 87, A-P 30, SD 60.
T. samboni Wom. 1936
Sens. with many branches. DS 2.8.6, plus a cluster of about 30. AW 76, PW 82, A-P 30, SD 56.
T. macropus Wom. 1936

TROMBICULA KEUKENSCHRIJVERI Walch 1923

Trans. Vth. Bien. Congr. Far East. Assoc. Trop. Med., p. 583, Singapore, 1923 (publ. 1924).

(Pl. i, fig. 1)

In the almost rectangular dorsal scutum with well-defined postero-lateral angles and the PL setae placed midway between the antero- and postero-lateral angles, this and the following species *T. pallida* Nagayo form a well-defined group.

From *T. pallida* it is to be distinguished as given in the key to species of the genus.

We have not been able to obtain any authentic material of this species. The figure of the dorsal scutum given in pl. ii, fig. 1, is drawn to scale from our standard data as derived from Walch's figures and details. The standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
64	70	32	24	14	20	48	44	50	—	45

The species was described from a solitary specimen found on man at Deli, Sumatra. It is to be noted that in his table Walch gives the arrangement of DS as 13.4.6.8.11.8.4, whereas from his figure the arrangement is 2.12.4.10.4.10.8.4. In the type specimen the sensillae were missing but the species is probably correctly placed in *Trombicula* s. str.

TROMBICULA PALLIDA Nagayo et al 1919

Verhdt. d. jap. pathol. Gesellsch., Tokyo, 9, 107, 1919; Amer. J. Hygiene, 1, (5-6), 569, 1921.

(Pl. ii, fig. 2)

Allied to the preceding in the form of the dorsal scutum, but distinguished therefrom as in the key to species.

Only the second of Nagayo's papers has been available to us, but through the great help of Prof. Dr. Takenouchi of the University of Tokyo we have been able to examine two microscopic preparations of this species from the Yamagata Prefecture, Japan.

The figure of the dorsal scutum which we give (pl. ii, fig. 2) is to scale from Nagayo's figures and details, aided by the two specimens studied. Our standard data for these specimens are as follows:

Loc. and Date	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
Yamagata, 28/6/19	-	65	70	32	23	18	18	53	36	48	60	32-45
„ 18/8/19	-	63	73	32	22	17	18	50	37	47	—	32-45

The arrangement of DS was, in the first, 2.13.12.14.+ , and in the second 2.11.12.+.

Nagayo gives little data beyond that the sensillae measured 64.8 long and that the first row of dorsal setae was 10-11 (13).

In his breeding experiments Nagayo, 1921, claims to have reared the larvae to adults, and to have obtained larvae from captured adults. He was unable, however, to detect any definite differences between the adults and nymphs of this species and those of *akamushi*, *palpalis*, *intermedia* and *scutellaris*.

We have also received from Prof. Dr. Takenouchi a preparation of an adult caught in the field in Yamagata Prefecture, Japan, in July 1920, which he states in his letter is "probably *Trombicula pallida*." Whether it is this species or one of the other Japanese forms it is briefly described here as follows:

Length 775 μ , width of propodosoma 395 μ , of opisthosoma 400 μ . Eyes, if present, invisible in the preparation. Crista 130, sensillary area transverse, dumb-bell-shaped as figured for *T. deliensis* by Walch 1923; SB 48 apart, sensillary setae hard to see and apparently broken, only 40 long. Tarsus I ovate, 202 by 91, metatarsus 130 long. Body thickly covered with long, slender, non-tapering setae, 55 to 80 in length, with short outstanding ciliations along whole length.

If this specimen is correctly placed, then it will not fit into the *akamushi-palpalis* group as given later in the key to the nymphs and adults of *Trombicula*. It will instead come between *deliensis* Walch and *tindalei* Wom. in the form of the sensillary area and the SB, and be nearer the latter in that the DS are not knobbed, although not pointed as in *tindalei*. It also differs from this last species in the longer DS and the different proportions of the front tarsi.

TROMBICULA MUNDA Gater 1932

Parasitology, 24, 143-174, 1932.

(Pl. ii, fig. 3)

This and the following species, *T. spicea* Gater, in the small size of the dorsal scutum (AW < 40) constitute a second fairly distinctive group of species.

From *spicea* it differs in the proportions of the scutum, the fewer ciliations on the sensillae and in the arrangement of the DS, as well as in other characters given in the key to species.

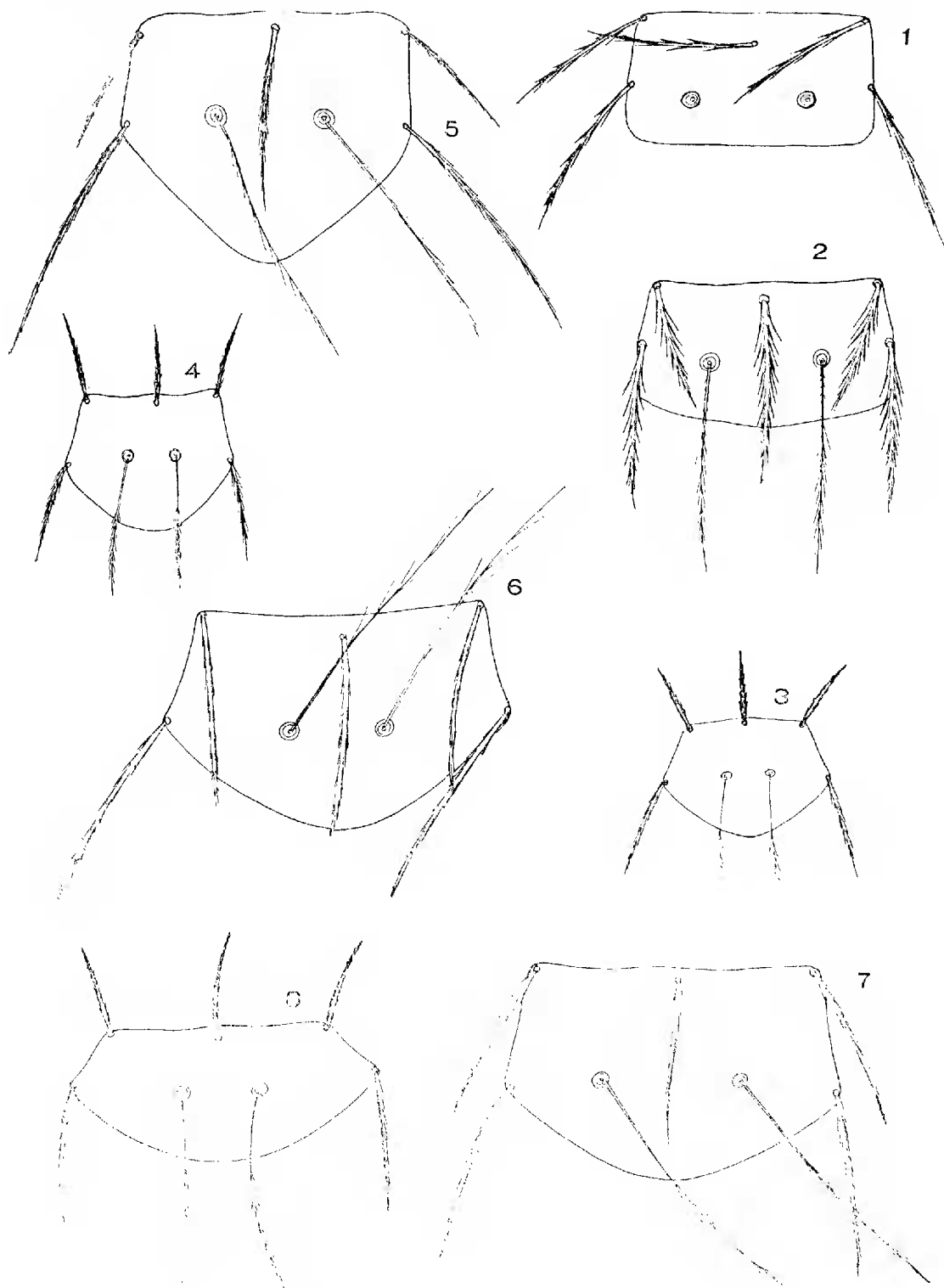
In addition to Gater's original description and figures we have been able to examine specimens from the original type locality and host. The specimens were labelled as from *Rattus rattus diardi* or *jalorense*, Kuala Lumpur, Selangor 1929. Gater also recorded it from *R. mulleri validus* (Miller) and from *R. malaisia* Kloss, from Sungei Buloh, Selangor.

The standard data for the two specimens measured are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
32.5	46.5	11.5	16	16.5	16.5	20	20	30	30	20-25
33	48	14	17.5	17.5	18	22	20	30	30	20-25

The DS are arranged 2.6.6.4.4.2.

Gater gives the scutal width as 48, and the length as 35, SB as 13, and the arrangement of DS as 2.6.6.2.4.4.2. It should be noted that his drawing of the scutum is not entirely in agreement with ours from the above specimens; he shows SB as very much nearer to the anterior margin, whereas they are about equidistant between anterior and posterior margins. The AW is also shown as rather too wide, and the lengths of the scutal setae are not to scale.



1. *Trombicula keukenschrijveri* Walch; 2. *T. pallida* Nagayo et al; 3. *T. munda* Gater; 4. *T. spicca*; 5. *T. acuscutellaris* Walch; 6. *T. japonica* (Tanaka); 7. *T. autumnalis* (Shaw); 8. *T. quadriense* n. sp.

TROMBICULA SPICEA Gater 1932

Parasitology 24, 143-174, 1932.

(Pl. ii, fig. 4)

This species was described from *R. malaisia* Kloss from Sungei Buloh, Selangor, Federated Malay States, and Gater also recorded it from *R. mülleri validus* (Miller) from the same locality.

We have been able to examine an authentic specimen from the latter host kindly forwarded from the Institute of Medical Research, Federated Malay States.

It differs from the previous species as discussed thereunder and as given in the key to species.

The figure of the dorsal scutum given here (pl. ii, fig. 4) is from the specimen examined, and drawn to scale. The standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
38	51.5	13	18	21.5	20	23	25	30	38	25-35

Arrangement of DS 2.6.4.4.4.2.

Gater gives the width of dorsal scutum as 55, and its length 41, and SB 15. As with his figure for the preceding species, this is not exactly to scale, but there seems no reason to doubt that the specimen before us is correctly determined.

TROMBICULA (PENTAGONELLA) ACUSCUTELLARIS Walch 1923

Kitasato Archives, 5, (3), 78, 1923; Gater, B. A. R., Parasitology, 24, 143-174, 1932; Sig Thor, Zool. Anz., 114, 30, 1936.

(Pl. ii, fig. 5)

In his original paper Walch only briefly described this species but gives a table of dimensions and detailed figures. He had originally but a single specimen from a rat from Deli, Sumatra. Gater 1932, however, records having compared Malayan material with specimens forwarded to him by Walch. Gater also recorded the species from *R. rattus diardi* from Sungei Buloh, Federated Malay States, from August 1929 to January 1930; once only on the same host from Kuala Lumpur, August 1929, and from Raub, Pahang, in March 1930. The only record from a human being (a woman school teacher) is by Gater from Setapak, Selangor.

To Prof. Dr. J. E. Dinger, of the Koningin Wilhelmina Institute, Batavia, we are indebted for an authentic specimen of this species, and we have also been able to examine another specimen from the Institute for Medical Research, Federated Malay States. We can therefore affirm Gater's identification of the Malayan and Sumatran specimens.

The standard data for the material before us are as follows:

Locality	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
F.M.S.	-	75	78	30	31	42	27	52	36	74	—	60-70
Batavia	-	76	82	32	29	40	27.5	54	40	76	78	60-75

Dorsal setae arranged 2.6.6.6.4.2.

Walch gives the following data: scutal width 77, length 68, AL 42, sensillae 77.

The figure of the dorsal scutum given in this paper is from the above two specimens, drawn to scale.

Sig Thor, 1936 erected the genus *Pentagonella* for this and other species on the pentagonal form of the dorsal scutum. As a similar form of scutum occurs in a number of otherwise well-defined genera it does not seem to be a valid character, and we do not accept *Pentagonella* as more than a subgenus at most.

TROMBICULA JAPONICA (Tanaka 1916)

Leptus autumnalis japonica Tanaka 1916, Igakkai Zasshi (in Jap.), 30, (22); 1918, Ikai Jiho (in Jap.), No. 1,228.

Trombicula autumnalis japonica (Tanaka et al.), Zentrbl. Bakt., Abt. 1, Orig, 116, 361.

(Pl. ii, fig. 6)

We have been able to study only Tanaka's description and figures in the last reference, the others not being available to us.

Because of its close similarity in the form of the dorsal scutum, Tanaka placed the Japanese form as a subspecies of the European *Trombicula autumnalis* (Shaw). To try to elucidate the status of Tanaka's species, we give comparative drawings to scale of the scutum of each form, that of the Japanese from the author's data and figures, and that of the European (pl. ii, fig. 7) from that of Hirst (Arachnida and Myriopoda injurious to Man, Brit. Mus. (N.H.), Econ. Ser. 6, pl. ii, 1917), but as no dimensions are given by Hirst for the dorsal scutum or are elsewhere available it is assumed for comparison that its AW = 80, as in the Japanese species.

From these drawings the comparative standard data are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
<i>japonica</i>	- 80	97	27	34	28	33	57	56	62	92	—
<i>autumnalis</i>	- 80	94	40	34	29	36	50	50	55	80	—

The arrangements of the dorsal setae respectively are 2.8.6.6.4.2 and 2.6.6.6.4.4.2.

The more important differences are therefore that in *japonica*—sensillae bases nearer together and slightly posterior of line of PL; sensillae longer and with fewer longer ciliations; the sides of scutum more divergent posteriorly; the different arrangement of dorsal setae.

Although the above differences are small they are yet significant, and it is obvious that Tanaka's form is not the same as *autumnalis* and must be raised to specific rank. Both species are closely allied to *acuscutellaris* in the pentagonal scutum and would come within the genus *Pentagonella* of Sig Thor. All three species have a similar long plain sensory seta on the tarsus of the third leg.

***Trombicula quadriense* n. sp.**

(Pl. ii, fig. 8; text fig. 1, A-E)

Description—Shape subrotund to subquadrate. Length to 340 μ , width to 300 μ . Dorsal scutum much wider than long (pl. ii, fig. 8), posterior margin strongly crescentic, anterior angles widely obtuse. Sensillae slightly in advance of line of PL, bases rather wide apart, setae filamentous, ciliated in distal half. Normal scutal setae as in standard data. Eyes 2 + 2. Chelicerae and palpi as in text fig. 1, D, C. Dorsal setae fairly long to about 40, pointed and shortly ciliated, arranged 2.8.6.6.4.2. All coxae with a single seta, a pair of setae between coxae II and between coxae III, ventral setae arranged thereafter 2.6.2.4.2, to 27 long. Legs comparatively short, I 204, II 170, III 220, tarsi with two claws and a longer median claw-like pulvillus.

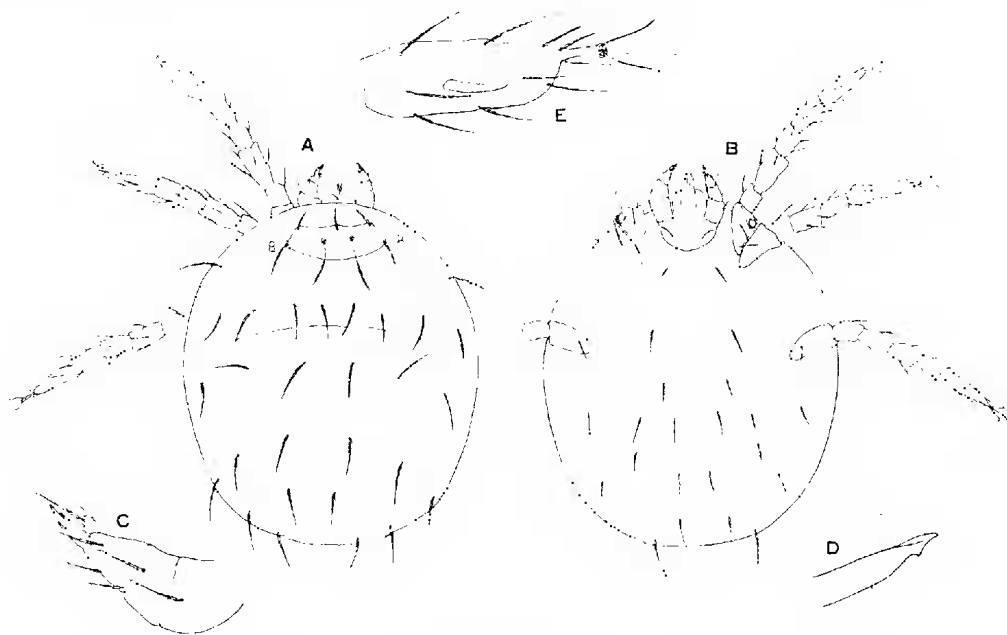
The standard data for three specimens are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
	62	92	24	19	23	19.5	32	26	43	—	27-38
	62	87	23	19	20	19.5	29	27	40	—	29-38
	56	81	22	16	20	18	—	25	44	—	27-38
Mean	- 60	87	23	18	21	19	30.5	26	42	—	27-38

The sensillae in pl. ii, fig. 8, and text fig. 1, A, were drawn from the specimens before permanently mounting. They afterwards became lost.

Loc. and Hosts—On rat, Cairns, Queensland, 1939 (W. G. H.); on *Rattus assimilis*, Intake, Queensland, 1940 (W. G. H.); on *Hydromys chrysogaster*, Intake, Queensland, 1940 (W. G. H.).

Remarks—A very characteristic species in the shape of the dorsal scutum, and the arrangement of the DS.



Text fig. 1

Trombicula quadriense n. sp.: A, dorsal view; B, ventral view; C, palp; D, chelicera; E, tarsus I.

TROMBICULA DENSIPILIATA Walch 1923

Kitasato Archives, 5, (3), 79, 1923.

(Pl. iii, fig. 1)

This species was described by Walch from a single specimen from a rat at Deli, Sumatra. We have not seen any material of this species and for our drawing of the dorsal scutum (pl. iii, fig. 1) and the standard data we have had to go entirely by Walch's figure and details. The species does, however, appear to be well differentiated as given in the key. The data given by Walch is: scutal width 81, length 51, AL 51, Sens. 45, DS arranged 2.8.9.12.11.6.4.4.2. From these we compute the standard data as follows:

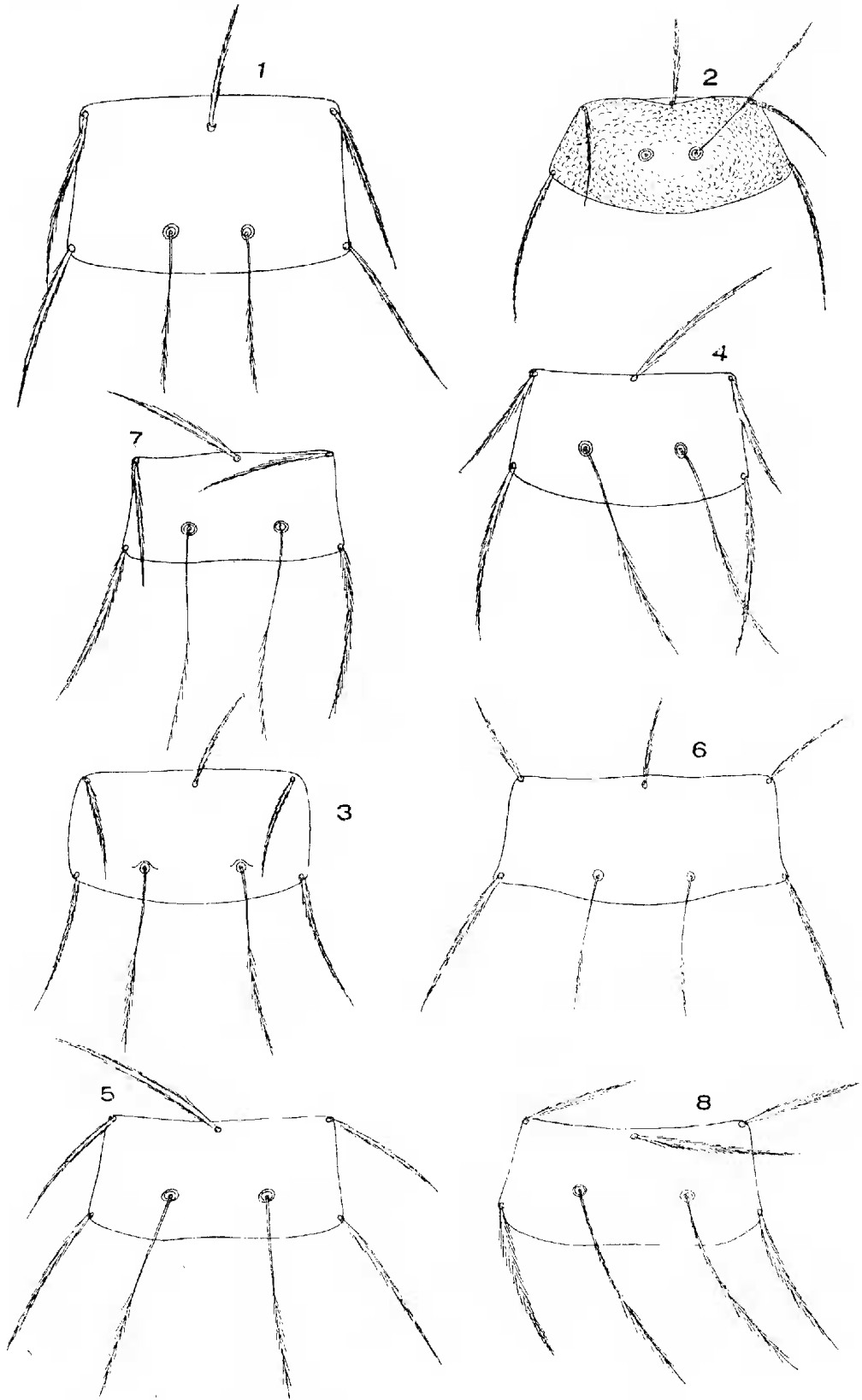
AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
72	80	22	40	11	39	37	51	50	45	50

Arrangement of DS 2.8.8.12.12.6.4.4.2.

Trombicula chiroptera n. sp.

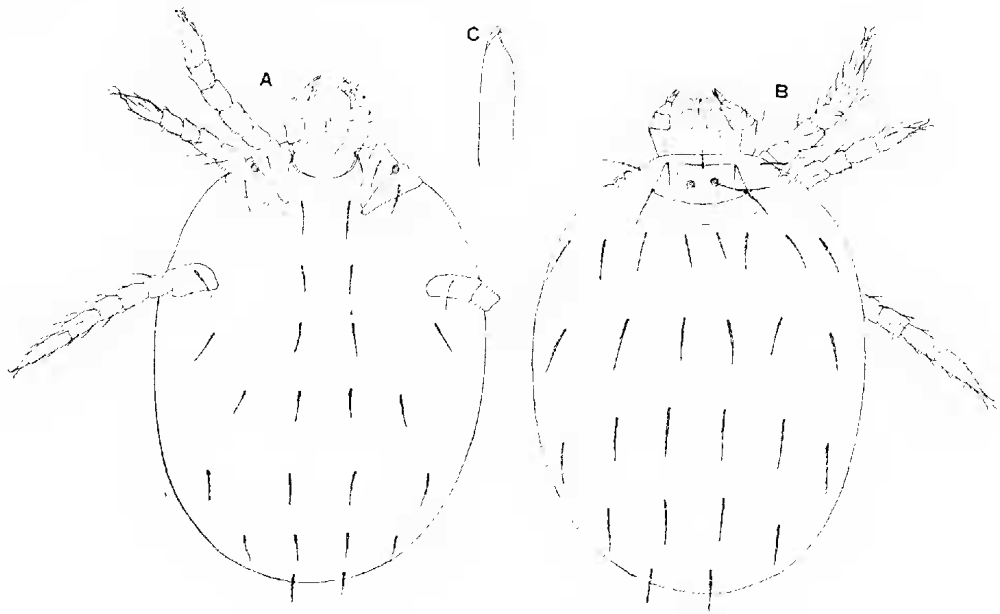
(Pl. iii, fig. 2; text fig. 2, A-C)

Description—Shape an elongate oval, with a suture behind the scutum. Length 350 μ , width 210 μ . Eyes 2 + 2, large and subequal and placed on lateral margins. Dorsal scutum as in pl. iii, fig. 2, wider than long, with shallowly convex



1, *Trombicula densipiliata* Walch; 2, *T. chiroptera* n. sp.; 3, *T. glyricolens* (Hirst); 4, *T. walchi* n. sp.; 5, *T. akamushi* (Brumpt); 6, *T. robusta* Gunther; 7, *T. bodensis* Gunther; 8, *T. fletcheri* n. sp.

posterior margin and strongly rugose surface. Sensillae filamentous, ciliated on distal half. Ordinary scutal setae pointed and shortly ciliated. AM and AL about equal and much shorter than PL. DS fairly long and tapering and shortly ciliated, arranged 2.8.6.6.4.2. Chelicerae as in text fig. 2, C. Palpi normal, tibial claw apparently bifurcate. All coxae with 1 seta, a pair of setae between coxae I and between coxae III, thereafter ventral setae arranged 4.4.4.4.2. Legs normal. I 160, II 160, III 180, tarsi with two claws and a longer claw-like pulvillus, I and II with the usual dorsal rod-like seta.



Text fig. 2

Trombicula chiroptera n. sp.: A, ventral view; B, dorsal view; C, chelicera.

The standard data for two specimens are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type (6)	48	76	14.5	24	17.5	32	25	19+	22+	—	20
Parat.	48	69	14.5	16	17.5	31	27	27	43	51	19

Loc. and Hosts—Type from residue in jar containing bats (unnamed and unlocalised but probably South Australian), in the South Australian Museum Collections. Paratype similarly with *Chalinolobus gouldi*, probably South Australian.

Remarks—Can be separated from other species as in the key and by the strongly rugose scutum.

TROMBICULA GLIRICOLENS (Hirst 1915)

Microtrombidium gliricolens Hirst 1915, Bull. Entom. Res., 6.

(Pl. iii, fig. 3)

Hirst described this species from a single specimen taken from the ear of *Mus rattus* (sic.) from Calcutta, India, March 1915.

His description is, however, rather vague and lacking in detail. The figure of the dorsal scutum given in this paper (pl. iii, fig. 3) is re-drawn to scale from Hirst's figure and details. The AW and PW are nearly equal and the sides con-

(⁶) Crushed and scutum damaged with broken setae.

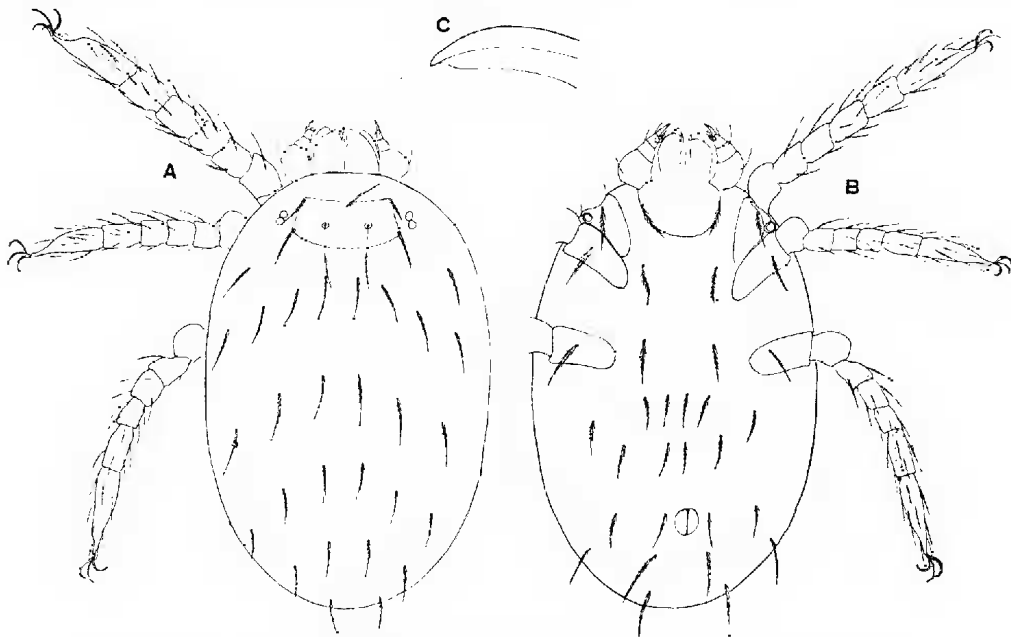
sequently almost parallel. The arrangement of DS is 2.8.8.8.6.4.2., and the standard data calculated from Hirst's figure and the few details he gives are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
60	65	28	28	11	25	30	30	40	55	—

***Trombicula walchi* n. sp.**

(Pl. iii, fig. 4; text fig. 3, A-C)

Description—Shape an elongate oval. Length 320 μ , width 210 μ . Eyes 2 + 2, equal and about two diameters from side of scutum. Dorsal scutum wider than long with slightly concave anterior margin and more convex posterior margin, AM and PL longer than AL, all tapering and shortly ciliated. Sensillae filamentous, ciliated on apical half, bases wide apart. Chelicerae as in text fig. 3, C. Palpi normal. Dorsal setae 45-50, long, pointed and ciliated and arranged 2.8.6.6.4.2. Coxae with a single long ciliated seta, a pair between coxae I and between coxae III, thereafter the ventral setae are arranged 6.4.4.4.2., the last two rows as long as the dorsal setae. Legs normal I 210, II 190, III 240, tarsi with paired claws and longer claw-like pulvillus, I and II with the usual dorsal rod-like seta.



Text fig. 3

***Trombicula walchi* n. sp.:** A, dorsal view; B, ventral view; C, chelicera.

The standard data are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
Type	-	57	67	27	22	17	28	52	37	54	—	45-50
Parat.	-	57	67	27.5	22	16.5	27	51	38	53	65	45-50

Loc. and Hosts—Type, on a slide (IA, 1 C, I) from Prof. Dinger, of the Institute for Bacteriology, Batavia. In his letter Prof. Dinger refers to this slide as *T. deliensis*, but on the slide it is marked "as very close to *akamushi*." A study of the figures given and the key to species will show the relationships of this species. The paratype is on a slide from the Institute for Medical Research, Federated Malay States, labelled *T. deliensis* and stated in writing to be from *R. rattus diardi* (Jk.) from Sardang, Selangor, 21 April 1932.

TROMBICULA ISSIKII Sugimoto 1938

J. Jap. Soc. Vet. Sci., 1938, 17, (1), 57-62, fig. 1-3.

(Text fig. 18 B)

This species was described in Japanese from *Capella hardwickii* (Gray), from Formosa. From Sugimoto's figures and the few dimensions he gives, the following standard data are interpolated:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
49	59	20	22	20	22	44	38	60	56	45-48

Dorsal setae arranged 2.6.6.6.4.2.

TROMBICULA AKAMUSHI (Brumpt 1910)

? *Trombicula coarctatum* (Berl. 1888), in Kitashima and Miyajima 1918, cited Walch Tr. Vth. Bien. Congr. Far East. Assoc. Trop. Med., 1923 (1924).

Kedani tanakai Kishida 1909,* cited Tanaka et al., 1930, Zentralblt. Bakt., Abt. 1, 116, Orig., 353.

Trombidium akamushi Brumpt 1910, Précis de Parasit., 2nd ed., 506.

Microtrombidium akamushi, Hirst 1915, J. Econ. Biol., 10, 79.

Leptothrombium akamushi, Nagayo et al. 1917, J. Exper. Med., 25, 255.

Trombicula akamushi, Hirst 1917, Arachnida injurious to Man (B. Mus. N. H.) Econ. Ser., No. 6; Nagayo et al. 1921, Amer. J. Hygiene, 1, (5-6), 569; Walch, 1923 (1924), Tr. Vth. Bien. Congr. Far East. Assoc. Trop. Med.; Gater, 1932, Parasitology, 24; Brumpt 1936, Précis de Parasitologie.

Microtrombidium brumpti Hirst, 1915, J. Econ. Biol. 10; syn. Ewing, 1925, Ann. Ent. Soc. Amer., 13, 381.

(Pl. iii, fig. 5)

This species, which is one of those indicated as vectors of the Japanese river fever or tsutsugamushi disease, was originally recorded from Japan. There, at certain seasons of the year, it occurs very plentifully upon voles.

Under the generic name of *Microtrombidium*, it was fully re-described and figured, although few dimensions were given, by Hirst 1915 (J. Econ. Biol., p. 78), also from Japanese material.

In 1916 (Ikai Jiho, No. 1,164, 1,701) (cited by Nagayo et al. 1921) Tanaka considered that two species of mites occurred upon voles in Japan. One, which was known to attack man, he regarded as the Kedani or Akamushi tsutsugamushi; the other he called the Yasodani or vole mite, or Pseudoakamushi.

In 1919 Nagayo et al. (Jap. J. Exper. Med., 3, 265) claimed to distinguish three species, and in 1921 (Amer. J. Hygiene, 1, (5-6), 569) brought the number of known Japanese species up to five, viz., *akamushi* (Brumpt 1910), *pallida* Nagayo et al. 1919, *palpalis* Nagayo et al. 1919, *intermedia* n. sp. and *scutellaris* n. sp. In this last paper the authors considered that *akamushi* (Brumpt 1910) was the same as Tanaka's "Kedani," the same as Miyajima and Okamura's "thin-haired type" and the same as Kawamura's "type A"; that *pallida* Nagayo was the same as Tanaka's "Pseudoakamushi," the same as Miyajima and Okamura's "type D"; that *palpalis* Nagayo 1919 was the same as Kawamura's "type C," and that *scutellaris* Nagayo 1921 was the same as Kawamura's "type B."

In 1930 (Zentralblt. Bakt. Abt. 1, 116, Orig., 353) Tanaka et al. reviewed the Japanese species. The Kedani mite he again referred to *akamushi* Brumpt but cited this as synonymous with *Kedania tanakai* Kishida 1909.* His *pseudo-*

* This reference seems important but is not available to us.

akamushi of 1916 he separated into A and B; the first he synonymised with *pallida* Nagayo 1919, and the second with *palpalis* Nagayo 1919.

As the name *pseudoakamushi* is therefore a complex of at least two species for which valid names, *pallida* and *palpalis*, are available, it should be dropped from literature.

In addition, Tanaka in 1930 described another species under the name of *Trombicula autumnalis japonica*, which has already been discussed.

In 1928 Fletcher, Lesslar and Lewthwaite recorded specimens from the Federated Malay States which "resemble *T. akamushi* even more closely than *T. deliensis*," and in 1932 Gater recorded *T. akamushi* from Selangor on *R. rattus diardi*, *R. r. jalorensis* and *Trichys fasciculata fasciculata* Shaw. The latter author also stated that it was common on man. Some of his material was examined by H. E. Ewing in America, who was also of the opinion that the specimens belonged to the Japanese *akamushi*. Through the kindness, however, of Dr. Takenouchi of the University of Tokyo, and of the Director of the Institute of Medical Research, Federated Malay States, we have been able to compare two slides of supposed *akamushi* from the Federated Malay States with authentic Japanese material. From this study we are able to satisfy ourselves that the specimens from the Federated Malay States do not agree with the Japanese material, nor with the figures and descriptions given by Nagayo and by Hirst. They are a new species, described in this paper as *T. fletcheri* n. sp. Whether Gater's and Fletcher's original material, however, was true *T. akamushi* still remains somewhat uncertain, but in all probability the Japanese species does not occur other than in Japan and Formosa.

The standard data, as used in this paper for the Japanese material before us are as follows:

Locality	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
Yamagata, 20/8/19	- 63	75	28	22	13	30	58	38	52	64	42-65	
" "	- 62	70	28	22	11	28	58	37	54	60	45-65	
Yamagata, 27/7/19	- 66	74	30	22	11	28	—	—	—	58	45-65	
" "	- 62	70	27	22	13	30	58	38	48	62	45-65	
Mean	- - -	63	72	28	22	12	29	58	38	51	61	42-65

The dorsal setae are arranged 2.8.6.8.6.†. In Hirst's figure they are shown as 2.8.6.10.8.4.2, but it would appear that some of the latero-ventral setae may have been included in the drawing as the result of too much depression of the specimen in mounting.

Nagayo (1921) claims to have reared this species through from the larvae to the nymph and adult, and also to have obtained larvae from captured adults. Beyond a slightly redder colour in the nymph and adults of *akamushi* than in *pallida*, he was unable to point to any very definite specific differences between either of these species or between these and *palpalis*, *intermedia* and *scutellaris*.

TROMBICULA ROBUSTA Gunther 1941

(Pl. iii, fig. 6)

This was described from birds, *Pitta mackloti* Temminck and *Microcca* sp. from Bulolo, T. N. G. The species, which is very close to the two following, can be separated as given in the key. The drawing of the dorsal scutum (pl. iii, fig. 6) and the following standard data are derived from Gunther's original drawings and descriptions. We have not seen any specimens.

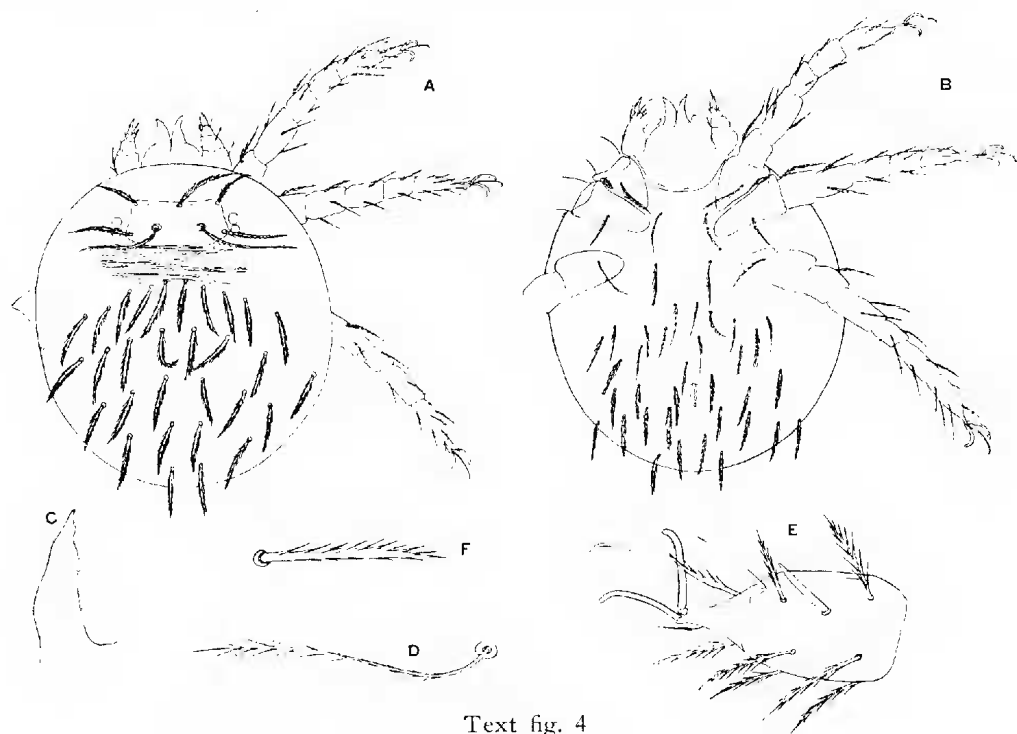
AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
73.5	82.5	27	29	8.5	28	25	28	47	41	—

Arrangement of dorsal setae, 2.12.8.8.4.2.

Trombicula fletcheri n. sp.

(Pl. iii, fig. 8; text fig. 4, A-F)

Description—Shape almost circular. Length $283\ \mu$, width $235\ \mu$. Dorsal scutum (pl. iii, fig. 8) pitted, wider than long, posterior margin shallowly convex and medially extending $8\ \mu$ behind line of PL, scutal setae moderately long, and fairly bushy; sensillae rather thick, ciliated as in text fig. 4, D. Eyes $2 + 2$, not far removed from sides of scutum. Dorsal setae fairly stout and coarsely ciliated, arranged 2.10.8.6.4.2.2 and 32-50 long. Venter: all coxae with 1 long (40) seta, a similar pair between coxae I and between coxae III, thereafter anterior of anus 8.8.8, posterior of anus 6.4.4.2; those behind the anus are 40 and of similar structure to the dorsal setae, the others are more slender and finer. Legs, palpi and chelicerae normal. Cuticle finely, transversely, striated.



Text fig. 4

Trombicula fletcheri n. sp.: A, dorsal view; B, ventral view; C, chelicera; D, sensilla of scutum; E, tarsus I; F, dorsal seta.

The standard data for the type and paratype are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
Type	-	62	74	32	20	15	27	52	35	48	65	32-50
Parat.	-	62	75	30	20	14	25	50	35	48	62	32-50

Loc. and Host—Two specimens permanently mounted sent from the Institute of Medical Research, Federated Malay States, and labelled as *Trombicula akanushi* (Brumpt), from *Rattus rattus* (*diardi* or *jalorensis*), Sungei Buloh, Selangor, 14 October 1930.

Remarks—From the key to species, the figures, and descriptions it will be seen that the above specimens do not agree with *akanushi* or any other known species. We have pleasure in naming it after Dr. W. Fletcher.

TROMBICULA BODENSIS Gunther 1940

Proc. Linn. Soc. N.S.W., 65, (5-6), 479, 1940.

(Pl. iii, fig. 7)

Of this species which was described from specimens taken on the mouse deer, *Tragulus borneanus* Miller, from the Bode River near Sandakan, British North Borneo, we have been able to examine the type slide from the School of Public Health, University of Sydney, as well as three paratypes.

The standard data for these specimens are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type - -	55	63	27	20	11	25	45	40	48	60	40-50
Parat. -	55	62	27	21.5	10	25	45	38	50	—	40-50
„ -	60	65	27	22	10	27	44	39	49	—	40-50
„ -	56	65	27	23	10	28	40	40	50	65	40-50
Mean - -	56.5	64	27	22	10	26	44.5	39	49.5	62.5	40-50

The posterior margin of the dorsal scutum reaches 3μ behind the line of PL, and the arrangement of the DS is 2.8.6.6.4.

There are some slight differences between certain of the above measurements and those given by Gunther, *e.g.*, the scutum is given by him as 75 wide and 37.5 long, whereas allowing for the fact that PW is somewhat less than the real maximum width, the latter value is only about 66-67. Similarly our values for the length of the scutum (ASB + PSB) are nowhere greater than 33 as against 37.5 given by Gunther.

TROMBICULA DELIENSIS Walch 1923

Kitasato Arch. Exper. Med., 5, (3), 63, 1923; Tr. Vth. Bien. Congr. Far East. Assoc. Trop. Med., Singapore, 1923 (publ. 1924).

= *vanderghinstei* Gunther 1940. Proc. Linn. Soc. N.S.W., 65, (3-4), 252.

(Pl. iv, fig. 1)

This species was originally recorded from Deli, on the east coast of Sumatra, where Walch found it on man and rodents and considered it to be the vector of the pseudotyphus of that region. It was apparently confined to the lower altitudes, up to 300 metres.

In 1940 Gunther described *T. vanderghinstei* from rats at Bulolo and considered that it might possibly be only a local variant of *deliensis*. From the comparison of our figures of the dorsal scutum of these two species and the data given for both it will be seen that Gunther's *vanderghinstei* is only a synonym of the Sumatran species.

Heaslip (Med. J. of Aust. 1941, 380) in his investigations into the "tsutsugamushi" fever of North Queensland (Cairns district) has shown that *T. deliensis* is the commonest species of larval *Trombicula* of that area, but he did not find it around Brisbane. It occurred plentifully on rats and the bandicoot, *Isodon torosus*, and out of 2,500 specimens from these hosts 90% were *T. deliensis*. It is apparently the vector of "tsutsugamushi" fever in North Queensland.

Of the material that we have examined in detail we give the following data:

Queensland:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Cairns -	63	81	32	21.5	13.5	27	55	46	60	62	50-55
„ -	62	76	30	23	13.5	29	56	46	65	62	50-55
„ -	62	76	30	23	13.5	27	54	43	60	60	50-55
„ -	65	76	30	23	13.5	28	54	43	65	65	45-55
„ -	60	73	27	22	13.5	27	54	43	62	—	45-55

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Cairns -	60	73	28	22	13.5	30	60	43	60	65	50-60
" -	62	75	30	22	13.5	30	55	43	60	62	50-60
" -	65	75	30	24	16	30	54	41	60	65	55-55
" -	65	77	30	24	13.5	27	56	43	63	65	50-60
" -	62	70	26	21	13.5	27	52	41	57	60	45-55
" -	60	73	30	22	13.5	30	56	40	62	60	45-60
" -	60	75	30	24	13.5	28	56	43	62	60	45-60
" -	65	81	32	23	15	30	60	46	65	—	50-60
" -	67	82	32	23	15	28	56	43	65	—	48-55
" -	65	78	32	24	15	28	57	46	62	65	50-55
" -	65	82	30	25	16	27	56	46	65	62	50-60
" -	65	78	30	23	16	28	54	48	62	65	48-55
" -	65	81	30	22	13.5	30	60	46	67	65	50-60
" -	65	76	29	25	16	30	57	43	65	62	45-55
" -	60	81	31	23	13.5	27	—	40	65	—	45-60
Mean - -	63	77	30	23	14	28	56	44	63	62	45-60

New Guinea—Type and three paratypes of *T. vanderghinstei*:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type - -	65.5	75	30	22	13.5	26.5	50	43	60	65	45-60
Parat. - -	65	76	31	25	13.5	30	53	42.5	61	65	45-60
" - -	—	—	—	—	—	27	60	42	64	65	48-60
" - -	64	71	27	26	14	26	54	43	62	65	45-55
Mean - -	65	74	29.5	24	13.5	27	54	42.5	61	65	45-60

In all the above the arrangement of dorsal setae is 2.8.6.6.4.2. as given by Walch and by Gunther. The other data given by Walch are: scutal width 74, length 37; AL 39, Sens. 61, and by Gunther: scutal width 84.4, length 50; AM 50, AL 46, PL 56, SB 28; these latter, however, are not quite in agreement with our measurements of his material.

TROMBICULA CORVI Kawamura and Yamaguchi 1921

Kitasato Archiv. Exper. Med., 1921, 4, 169.

(Text fig. 7 A)

Hatori (1919), Ann. Trop. Parasitol., 13, 233, referred to a species of *Trombicula* on fowls in Formosa, but while regarding it as new did not describe or figure it.

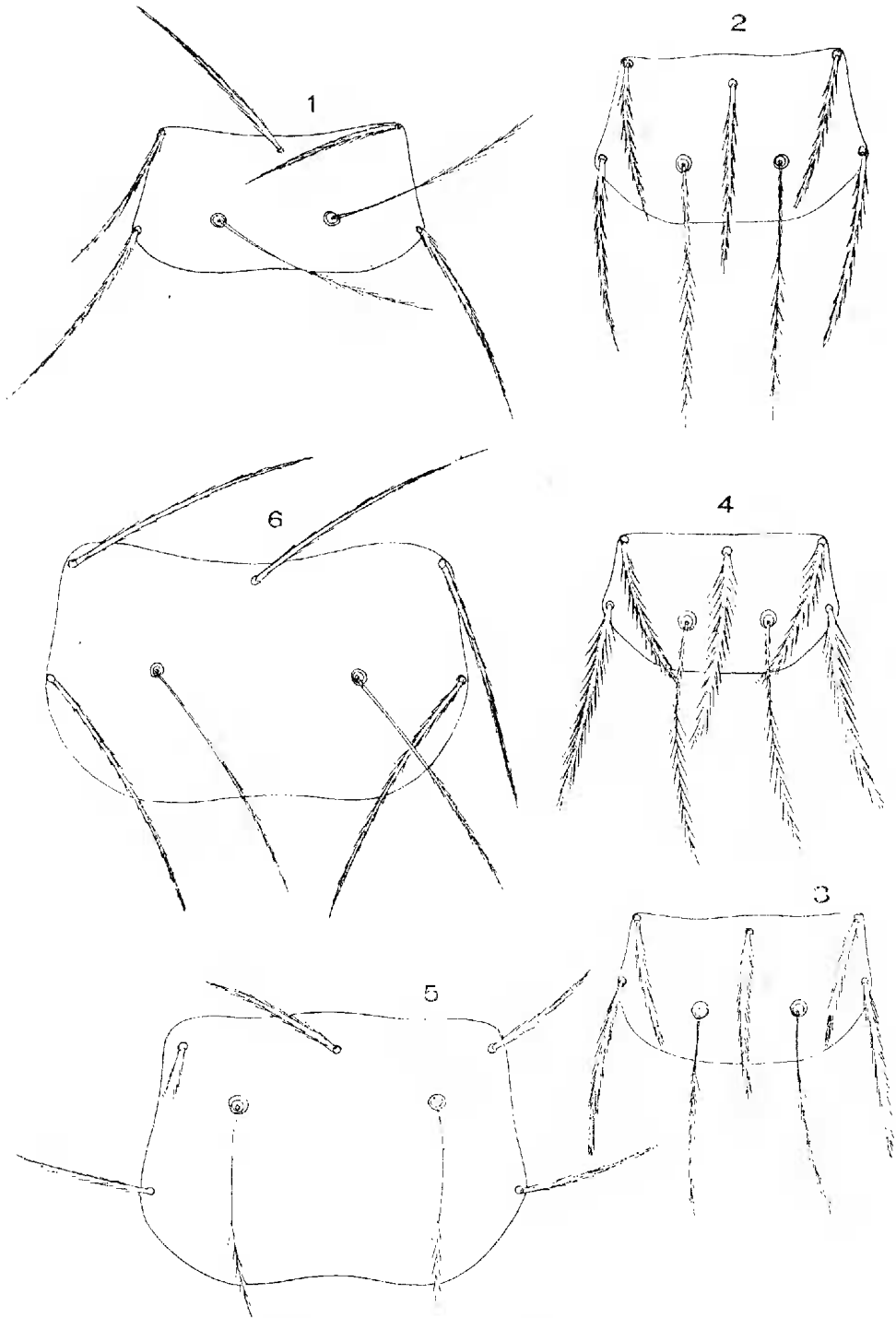
Later, in 1921, Kawamura and Yamaguchi, having received a slide of this species from Hatori himself, published a number of details and referred to it as *Trombicula corvi* Hatori. As we can find no reference to this specific name having been published by Hatori, it would seem that the species should be known as *T. corvi* Kawamura and Yamaguchi 1921. These authors give only a few details as in the key, and from these the figure of the dorsal scutum has been constructed. It must be remembered, however, that except for the values given by Kawamura and Yamaguchi it is hypothetical.

TROMBICULA SCUTELLARIS Nagayo 1920

Verhandl. d. jap. pathol. Gesellsch., Tokyo, 10, 471, 1920; Amer. J. Hygiene, 1, (5, 6), 569, 1921.

(Pl. iv, fig. 2)

Of this species we have not seen any authentic material. It is very close to *palpalis* Nagayo and may possibly be synonymous with it. The first reference has not been available to us, but the standard data and figure of the dorsal scutum



1. *Trombicula deliensis* Walch; 2. *T. scutellaris* Nagayo; 3. *T. palpalis* Nagayo;
4. *T. intermedia* Nagayo; 5. *T. rara* Walch; 6. *T. rioi* Gunther.

given here is from Nagayo's 1921 figure and data. The figure is to scale and the data as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
57	69.5	26.5	28.5	15	26.5	51	43	53	70	—

The arrangement of dorsal setae is 2.10.10(12).10(8).6.4. According to Nagayo's figure the scutal setae are thick and strongly ciliated and the sensillae with very short ciliations on the basal third and thereafter with long ones. It also differs from the closely allied species *palpalis* and *intermedia* in that A-P is very much greater than SD.

TROMBICULA PALPALIS Nagayo et al. 1919

Verhandl. d. jap. pathol. Gesellsch., Tokyo, 9, 107; Amer. J. Hygiene, 1, (5, 6), 569, 1921.

(Pl. v, fig. 3)

We have only been able to refer to Nagayo's second paper, but have examined two authentic specimens from Yamagata, Japan (coll. July 1920).

Nagayo (1921) gives the following details: scutal length 37.7, width 71.7, Sens. 61.4. Our standard data for the two specimens examined are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
62	67	28	26	13	17	47	36	48	56	35-50
58	66	25	22	13	17	45	38	48	—	—

Dorsal setae arranged 2.10.10.+.

Nagayo (1921) claims to have reared this species through from larvae to adult, and to have obtained larvae from the adult. He was unable, however, to point to any very definite specific differences between the nymphs and adults of this species and those of *akamushi*, *pallida*, *palpalis* and *scutellaris*.

TROMBICULA INTERMEDIA Nagayo 1920

Verhandl. d. jap. pathol. Gesellsch., Tokyo, 10, 471, 1920; Amer. J. Hygiene, 1, (5, 6), 569, 1921.

(Pl. iv, fig. 4)

Of this species, which is very close to the preceding two species, we have only been able to refer to Nagayo's second paper. Our figure is from his figure and data and drawn to scale. Our standard data, also from his details, are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
53	60	22.5	23.5	23	18	53	41	57	65	—

Arrangement of dorsal setae, 2.10.8.8.6.4.2.

Nagayo states that he has reared the larvae of this species as far as the nymph, but fails to find any definite morphological distinctions between the nymph of this and the other Japanese forms, *akamushi*, *pallida*, *palpalis* and *scutellaris*.

TROMBICULA RARA Walch 1924

Tr. Vth. Bien. Congr. Far East. Assoc. Trop. Med. Singapore, 1923 (publ. 1924).

(Pl. iv, fig. 5)

This species was recorded from man from Sumatra. We have not been able to obtain any authentic material but Walch gives the following data: width of scutum 104, length 74, AL 33, Sens. 57. DS in text 6.4.4.2, in fig. 2.6.2.4.4.2, and 34 μ long. From his figure and the above data we give the following standard data on the basis of ASB + PSB, i.e., depth or length of scutum (SD) = 74.

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
85	104	54	25	49	40	40	33	40	57	34

From Prof. Dr. J. E. Dinger of the Koningen Wilhelmina Institute v. Bacteriologic, Batavia, we have a slide, I A. l.c. II., unnamed, which on examination proves to be this species. The standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
92	110	47	27	47	40	40	47	55	60	40

Arrangement of DS, 2.6.6.4.2.

TROMBICULA RIOI Gunther 1939

Proc. Linn. Soc. N.S.W., **64**, (1-2), 80, 1939.

(Pl. iv, fig. 6)

Gunther described this species from *Megapodius duperreyi*, the bush fowl of New Guinea.

In his description he gives the following data: scutal width 120, length 69, AM 66, AL 68, PL 75, SD 50, Sens. 75, DS 2.14.12.4.6.8.10.8.4.

We have been able to examine the type and three paratypes, which gave the following data:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 99	111	53	28	33	31.5	60	70	75	70	35-70
Parat.	- 99	110	55	28	33	33	61	70	73	—	—
„	- 102	110	56	30	35	32	60	67	70	70	35-65
„	- 100	110	54	30	35	30	60	72	72	68	35-70
Mean	- 100	110	54.5	29	34	31.5	60	70	72.5	69	35-70

Dorsal setae arranged, 2.14.16.12.+.

TROMBICULA WICHMANNI (Oudms. 1905)

Trombidium wichmanni Oudms. 1905, Ent. Ber., **1**, (22), 217; 1906, Nova Guinea, **5**, 106, 132, pl. iv, fig. 67-68; 1908, Tijds. Entom., **51**, 25; 1909, *ibid.*, **52**, 38.

Allotrombidium wichmanni Oudms. 1906, Ent. Ber., **2**, (28), 58-59.

Trombidium (Heterotrombidium) wichmanni, Verdun 1909, Cr. Soc. Biol., Paris, **67**, 246.

Microtrombidium wichmanni Oudms. 1909, Ent. Ber., **3**, (50), 20; 1912, Zool. Jahrb. Suppl., **14**, 9.

Trombicula wichmanni, Gunther 1940, Proc. Linn. Soc. N.S.W., **65**, (5, 6), 480, 4-6.

(Pl. v, fig. 1)

This species was originally described from New Guinea from *Goura coronata*, and also from man from the North Celebes. Gunther records it from the mouse deer (*Tragulus borneanus* Miller 1902) from Bode River, British North Borneo, 1939.

We have been able to examine Gunther's type as well as three other specimens, all from the same series from British North Borneo. From these our standard data are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- - 79.5	93	40	25	27	31.5	43	48	58	63	45-65
Parat.	- - 76.5	91.5	38	25	26	31.5	43	46	58	63	—
„	- - 79.5	93	38	23	25	31.5	—	46	58	63	—
„	- - 80	93	40	24	27	31.5	43	46	59	—	—
Mean	- - 79	92.5	39	24	26	31.5	43	46.5	58	63	45-65

Arrangement of dorsal setae, 2.6.6.4.2.2.

Trombicula hatorii sp. nov.

Trombicula pseudoakamushi Hatori (nec. Tanaka) in Kawamura and Yamaguchi, Kitasato Archives Exper. Med., 4, 169, 1921.

(Pl. v, fig. 5)

Hatori (Ann. Trop. Med. Parasitol., 13, 233, 1919) described a species of larval *Trombicula* from Formosa under the above name, and claimed to have reared from these larvae the nymphs and adults which were identified with *T. mediocris* Berl. (= *minor* Berl.). Kawamura and Yamaguchi 1921 also worked on the Formosan species and described and figured what they considered Hatori's form in much detail. They agreed with the correlation of the larvae and adult with *mediocris*. The drawing of the dorsal scutum given herein is based to scale on Kawamura and Yamaguchi's figure and data, from which the following standard data are deduced:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
72	85	37	27	27	27	37	37	50	55	45

Dorsal setae arranged, 2.6.6.4.2.

This species is closely related to *T. zeichmanni* Oudem., as will be seen by a comparison with the standard data. It differs in that the SB are only slightly in advance of the line of PL, that the posterior margin of the scutum is not flattened medially, and in the different lengths of the normal scutal setae.

TROMBICULA MINOR Berlese 1904

Trombicula minor Berl. 1904, Acari nuovi Manip. IV, 135, pl. xv, fig. 4; Womersley 1939 (July), Trans. Roy. Soc. S. Aust., 63, (2), 152; Gunther 1939 (December), Proc. Linn. Soc. N.S.W., 64, (5, 6), 466.

Trombicula mediocris Berl. 1912, Redia 8, fasc. 1, 94; Gunther 1940, Proc. Linn. Soc. N.S.W., 65, (5-6), 477.

Trombicula hirsti Sambon 1927, Ann. Mag. Nat. Hist., (9), 20, 157; nec Hirst 1929, Ann. Mag. Nat. Hist., (10), 3, 564; nec Womersley 1934, Rec. S. Aust. Mus., 5, (2), 212.

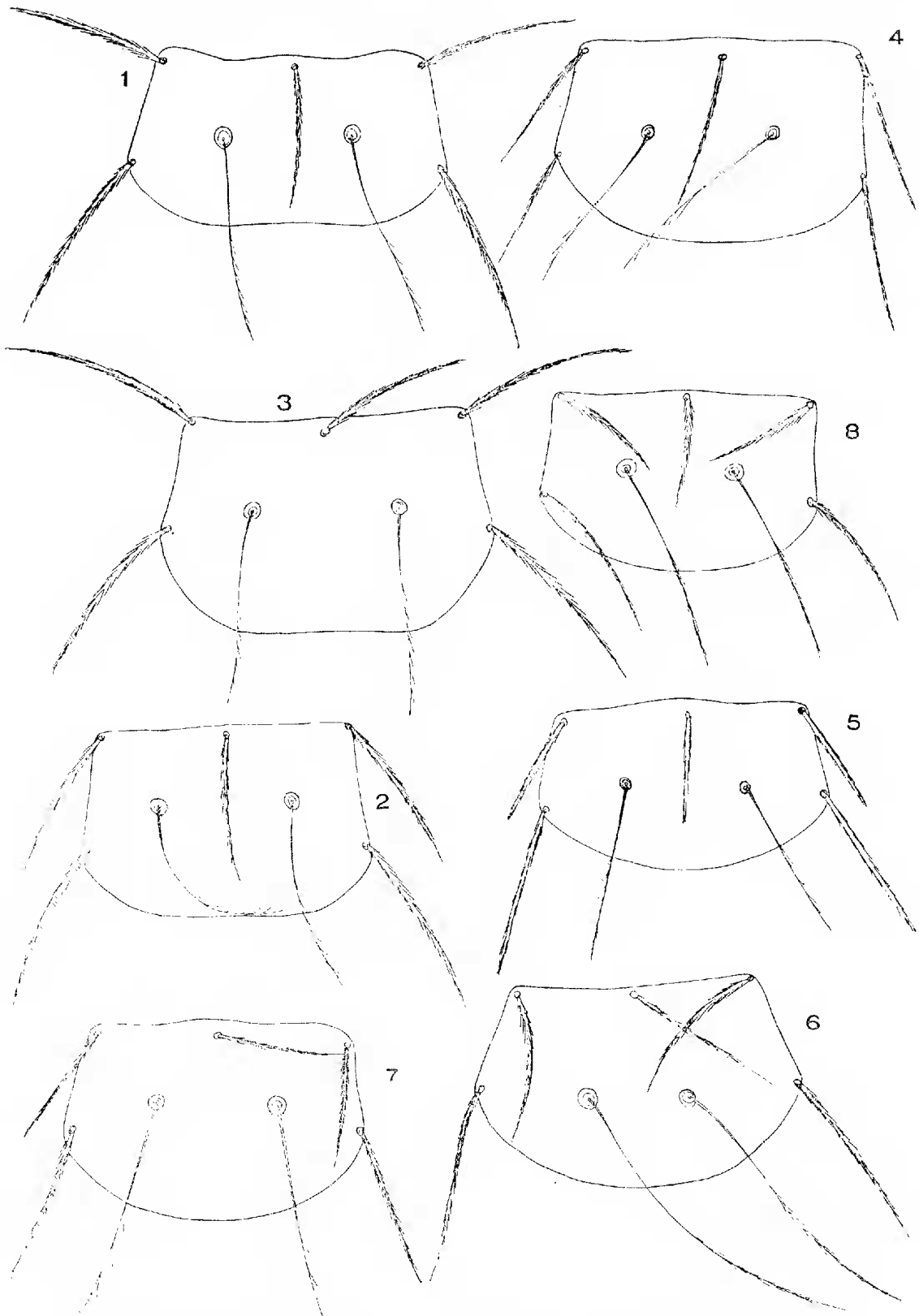
(Pl. v, fig. 2)

Although Berlese in his description and figure of *T. minor* from Java makes no reference to the presence or absence of eyes, yet his species (specimen imperfect) is probably, as suggested by Kitashima and Miyajima 1920, the nymph of *T. mediocris* Berl. 1912, also from Java, which has a very well developed eye closely adjacent to and on each side of the sensillary area of the crista.

Gunther's nymphs in size, dimensions of front tarsi and metatarsi, and in the dorsal setae agree with *minor*, but also possess a single eye on each side of the crista as in *mediocris*. An adult female from Innisfail, Queensland (1939, W. G. H.), agrees in size and all other characters with *mediocris* and, except in size and presence of eyes, also with *minor*.

This species as the larvae is the common "itch mite" of the Queensland scrub, at high altitudes. Heaslip (Med. J. Aust., 1941, p. 380), in his studies of "tsutsugamushi" fever in North Queensland, records it from man at Lake Barrine at 1,500 feet, and although he collected adults from near sea level, the larval form was not found amongst 2,500 specimens from rats and bandicoots. The usual hosts of the larvae appear to be birds (*vide* Gunther 1939, C).

T. minor Berl. (larvae) occurs on rats and on the bandicoot, *Isodon torosus*.



1, *Trombicula zeichmanni* Oudms.; 2, *T. minor* Berl. f.p.; 3, *T. minor* v. *deliculis* Walch (from Gunther's material from N.G.); 4, same from Walch's material; 5, *T. hatorii* n.sp.; 6, *T. novae-hollandiae* Hirst; 7, *T. samboni* Wom.; 8, *T. macrofus* Wom.

We give the following data from two specimens from Innisfail, and one from Lake Barrine.

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Innisfail	- 73	85	40	23	35	35	43	46	53	—	50-55
"	- 73	85	40	24	35	35	—	45	52	—	50-55
Lake Barrine	79	89	43	25	35	36	41.5	46.5	52	—	50-55
Mean	- - 75	86	41	24	35	35.5	42	46	52	—	50-55

Arrangement of dorsal setae, 2.6.6.4.2.

TROMBICULA MINOR v. DELIENSIS Walch 1923

Trombicula pseudoakamushi v. *deliensis* Walch 1923.

Trombicula hirsti Gater 1932.

Trombicula hirsti v. *morobensis* (nom. nud.) Gunther 1938.

Trombicula hirsti v. *bulolocensis* Gunther 1939.

(Pl. v, fig. 3, 4)

This form appears to be but a variety of the larvae of *Trombicula minor* Berl. The differences, as will be seen from the key to species and from the figures, lie only in the size of the scutum and the longer scutal setae. Walch described it as a variety of Hatori's Formosan species *T. pseudoakamushi* (non Tanaka), from Deli, Sumatra. Gunther records it as common in the somewhat higher altitudes of New Guinea from many hosts, bandicoots, bush fowl, bush pig, bush turkey, cassowary, pigeon, and as a casual on rail, swamp hen and man. It was from this variety that he bred his nymphal *T. minor* Berl. It also occurs at Selangor, Federated Malay States. We have examined the following 21 specimens from New Guinea, and also a single specimen from Selangor, Federated Malay States, 1929, labelled as *T. hirsti*, with the following results:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	DS
F.M.S.	- 85	106	41.5	23	35	33	43	50	56.5	41-58

Dorsal setae, 2.6.6.4.2.

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type slide, N.G.	- 83	99.5	44	30	40	38	48	53	56.5	60	—
" " "	- 83	99.5	44	26.5	40	33	53	51.5	58	60	—
" " "	- 83	98	44	28	38	33	—	50	55	60	—
" " "	- 83	96	44	26.5	36.5	35	—	50	56.5	60	—
" " "	- 80	96	41.5	23+	36.5	31	48	51.5	58	60	—
" " "	- 83	99.5	43	23+	36.5	35	48	53	58	60	—
" " "	- 83	99.5	44	25	36.5	33	48	53	60	61.5	—
" " "	- 84	101	46.5	25	36.5	33	50	55	60	63	—
" " "	- 83	95	43	26.5	38	35	50	54	60	60	—
" " "	- 84.5	103	44	26.5	38	35	50	55	60	60	—
" " "	- 84.5	96	43	26.5	38	33	—	55	58	60	—
Slide 2, N.G.	- - 81.5	96	41.5	25	40	35	45	49	55	58	—
" " "	- - 83	98	43	25	41.5	35	45	49	55	53	—
" " "	- - 91	103	46	26.5	41.5	33	45	58	64	56	—
" " "	- - 83	96	44	25	40	33	43	48	56	50	—
Slide 3, N.G.	- - 83	99	46	25	40	35	50	53	50	60	—
" " "	- - 83	96	45	26.5	38	33	50	53	61	60	—
" " "	- - 83	104	46.5	25+	40	38	50	58	62	51	—
Slide 4, N.G.	- - 86	103	47	28	40	38	50	58	54	—	—
" " "	- - 91	106	45	28	38	35	46.5	53	58	—	—
" " "	- - 91	103	45	28	38	33	47	53	58	—	—
Mean	- - - 84.5	99.5	44.5	26.5	38.5	34.5	48	53	58.5	58.5	50-60

Arrangement of dorsal setae, 2.6.6.4.2.

That Walch's description and figures agree with the above is apparent, when the standard data deduced from them are compared. These data are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
82.5	93.5	36	28	33	33	46	48	56	58	44

He gives AL = 46 and shows the other setae as almost equal.

TROMBICULA NOVAE-HOLLANDIAE Hirst 1929

Proc. Zool. Soc. London, 1929, 172; Womersley 1934, Rec. S. Aust. Mus., 5, (2), 213.

(Pl. v, fig. 6)

Of this species we have measured 14 specimens from Kangaroo Island, South Australia (including 9 co-types), 9 specimens from Tasmania and 4 specimens from Cairns, Queensland.

The maximum, minimum and mean data of this material are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Maxima -	78	102	32	38	29	38	62	54	78	100	—
Minima -	62	90	27	32	24	32	49	46	57	90	—
Mean -	71	96.5	31	35	27	35	53.5	51	68	95	50-80

The arrangement of dorsal setae is, 2.6.6.6.4.2.

TROMBICULA SAMBONI Wom. 1936

(Pl. v, fig. 7; text fig. 5)

Womersley 1939, Trans. Roy. Soc. S. Aust., 63, (2), 153.

= *Trombicula hirsti* Hirst 1929, nec Sambon 1927; Womersley 1934 nec Sambon 1927.

This is the "ti-tree itch" mite of South Australia. We have measured 10 specimens from Robe, the type locality, and 8 specimens from Port McDonnell.

The following are the standard data from all this material:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Highest -	81	91	38	26	39	32	41	44	52	72	—
Lowest -	75	84	34	23	31	27	37	38	43	65	—
Mean -	78.5	87	36	24	36	30	38	42	48	68.5	30-58

Dorsal setae, 2.6.6.6.4.2.

While this paper was in preparation two visits were made by one of us (H. W.) to the Robe district of South Australia to ascertain the prevalence of the larvae of this species at that time of the year (April) for certain experimental reasons.

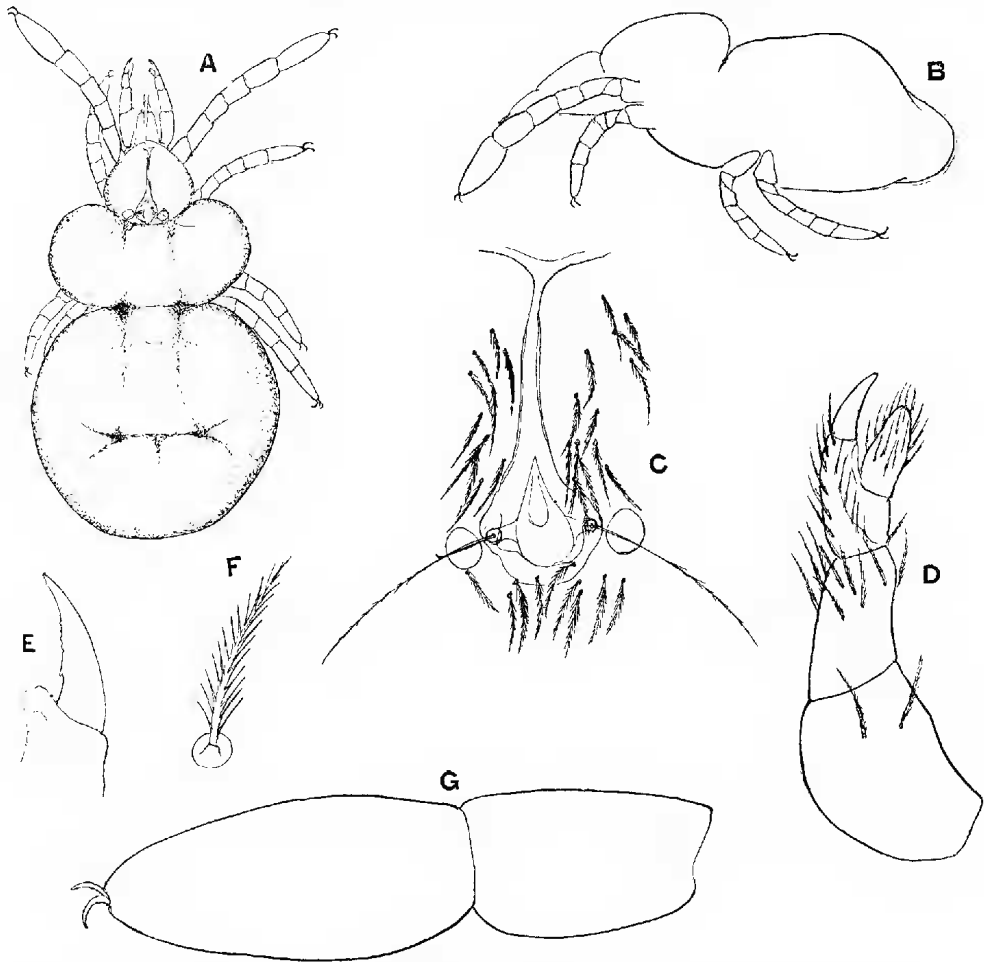
Inquiries showed that the larvae, locally known as "red spider" or "ti-tree itch," were well known to residents throughout the coastal area from Policeman's Point on the Coorong to Port McDonnell. The mites occur mainly on open grassy patches amongst the ti-tree scrub, frequented by campers and duck shooters. Walking amongst the scrub or lying on the grass invariably leads to infestation of the person, and any objects on the ground, such as one's boots, a gun or handkerchief, soon become covered with numerous specimens of these tiny yellowish active mites. They are more prevalent on warmer days, particularly from September to January but occur throughout the year, and even on the occasion of our visits they were abundant although the weather was cold and wet.

In the Robe district at the present time they occur on the introduced rabbit, which abounds, as small yellowish clusters in the ears and around the eyes. Almost any rabbit seemed to carry some. Old residents stated that they could remember the "itch" from their earliest days, 70 to 80 years ago, although rabbits did not appear in the district until about 50 years ago. Before rabbits became common, native animals such as wallabies and bandicoots were abundant, but are now extinct. It appears reasonable, therefore, to assume that the mites were carried by such native animals, and that as these were replaced by rabbits the mites transferred themselves to the latter.

The mites commonly attack cattle, horses and sheep, causing severe irritation and even bleeding, with subsequent loss of condition; in fact, one person informed us that he had lost cattle as a result.

On cattle and man the mites attach themselves singly and not in clusters as on the rabbits or on the hocks of sheep. On man they do not, as believed by local residents, burrow under the skin, but attach in the normal way by the mouth parts only, and are probably soon detached by scratching or rubbing of the clothing.

The bites are very irritating and some people seem to suffer a slight feverish reaction, although as far as known this particular species is not a vector of disease,



Text fig. 5

Trombicula samboni Wom. Adult: A, dorsal outline; B, lateral outline; C, crista and eyes; D, palp; E, chelicera; F, dorsal seta; G, tarsus and metatarsus I.

as are some allied species from Japan, New Guinea and Queensland. The site of attack on man is chiefly on the legs, around the waistline where clothing fits tightly and frequently on the scrotum. During the first visit nymphs or adults were not found, but intensive search on the second visit discovered numerous specimens of both stages in the black soil, chiefly in the top inch, and especially near spots where rabbits had been scratching and stamping. While finding of adults in the field is not absolute proof of their association with the larvae, the fact that in this area only the one larval species is known, strongly supports the view that

the larvae and adults are of the same species. Nevertheless, breeding experiments are being made to check this conclusion.

Adult of Trombicula samboni Wom. — Colour in life red except the propodosoma which is colourless except for deeply pigmented eyes. Shape a figure of 8, with the posterior portion broader than the anterior portion. Length (excluding gnathosoma) 1,200; width, anterior portion 690, posterior portion 860. Crista distinct, 170, sensillary area roughly triangular with paired sensillae, 118 long, and shortly finely ciliated on distal half, SB 47. Eyes 1 + 1, large and closely adjacent to sensillary area, deeply red pigmented in life, but difficult to observe after death except in freshly mounted specimens. Legs short, except I; I 775 long, II 520, III 600, IV 680, tarsus I conspicuous, 206 long by 86 wide, metatarsus 137 long. Clothing of thickly placed, ciliated, pointed setae, 40 long, with the ciliations long and outstanding, all setae uniform. Genital opening with three pairs of discs.

Nymph — Similar to adult in all details except size and having only two pairs of genital discs. Length 1,000, width, anterior portion, 600, posterior portion 720.

TROMBICULA MACROPUS Wom. 1936

Womersley 1936, J. Linn. Soc., London, (Zool), 40, (269), 112.

(Pl. v, fig. 8)

The mean, maximum and minimum data for seven specimens of this species are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Maxima	- 80	85	35	24	35	30	33	38	52	65	—
Minima	- 72	78	30	22	30	27	30	30	46	65	—
Mean	- 76	82	33	24	32	30	32	35	50	65	30-50

Dorsal setae arranged 2.8.6.+.

TROMBICULA CERVULICOLA Ewing 1931

Proc. U.S. Nat. Mus., 1931, No. 2,908, 80, Art. 8, 13, pl. i, fig. 3.

(Text fig. 18, A⁽⁷⁾)

This species was described from specimens from the Barking Deer (*Cervulus aureus*) from Muktesar, Kumaun, India.

Ewing's descriptions give no dimensions beyond the length and width of a "slightly engorged larva."

He regards the species as near to *acuscutellaris* Walch, differing in the scutum not being so angulate posteriorly and in the fewer setules on the sensillary setae. The dorsal setae are given as 26 in number.

From the details available it is not possible to place this species in the key. But from Ewing's figure of the dorsal scutum and assuming AW at 56, we get the following standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
56	64	26	20	22	24	34	32	52	44	?

ON THE CORRELATION OF THE LARVAE WITH THE NYMPHS AND ADULTS OF TROMBICULA

Although a large number of larval species of Trombiculinae are known, only a very few of these are also known from either the nymph or adult or both stages. Because of the importance of the larvae of these mites as vectors of disease to man from animals, it is of the utmost importance that an intensive study of their life histories should be made with a view to clearing up the whole question.

(7) To no definite magnification.

In America, according to Ewing, nymphs and adults of the itch mite or "chigger" have been reared and it has been shown that the adult, *T. cinabaris* Ew., is synonymous with the larva known as *Trombicula irritans* (Riley), which name has priority. In England the common "harvest mite," *Trombicula autumnalis*, has also been reared by Hirst to the nymphal stage.

Within the area covered by this paper, out of 30 recognised larval species of *Trombicula* s. str., at the most only four can be definitely correlated with nymphs or adults; these are *akamushi* Brumpt, *deliensis* Walch, *minor* Berlese, and *samboni* Wom. In addition two other species, *signata* Wom. and *tindalei* Wom., are known as nymphs from captured material but are unknown as larvae or at least uncorrelated with any known larvae. The life-cycle of *T. akamushi* seems to have been fairly definitely established by a number of Japanese workers since 1916, the principal of whom were Nagayo et al., Kawamura and Yamaguchi, and Miyajima and Okumura. None of these workers, however, appear to have identified the nymphal and adult stages with any known species.

In 1917 Hatori studied the tsutsugamushi disease of Formosa, and besides claiming to have reared the nymphs and adults from the larvae of *akamushi*, recorded another larval species under the name of *pseudoakamushi* (non Tanaka) (= *hatorii* n. sp. The adults of this second form he found living free in the soil, and considered it might be synonymous with Berlese's *mediocris* (= *minor* Berl.) from Java.

In 1921 Kawamura and Yamaguchi also studied the Formosan species and confirmed Hatori's rearing of both species, also referring *pseudoakamushi* to *mediocris* Berl.

In 1939 Gunther, in New Guinea, reared nymphs from the larvae, then known as *T. hirsti* v. *buloloensis* Gunther, which one of us (H. W.) was able to identify with *T. minor*, and in Queensland W. G. Heaslip collected an adult of this species. The third species to be reared through is *T. deliensis* Walch, of which Walch himself reared and described the nymph and adult. This species cannot yet be referred to any known adult species. In the present paper the nymph and adult of the "tree-itch" of South Australia are also described.

In 1921 Nagayo et al. also claimed to have reared nymphs and adults from four other species from Japan, namely *palpalis*, *pallida*, *intermedia* and *scutellaris*. They were unable, however, to point to any specific differences between any of these nymphs or adults and those of *akamushi*, hence the validity of these species is uncertain at present, although the larvae seem to be well differentiated as in the key.

The nymphal and adult stages of those species known as such from the area under review can be separated as follows:

- | | | |
|---|--|------------------------|
| 1 | Eyes 1 + 1, closely adjacent to the sensillary area. | 2 |
| | Eyes apparently absent. | 5 |
| 2 | Colour in life creamy white. | 3 |
| | Colour in life red. Size 1.2 mm. long, width of opisthosoma 860 μ . DS pointed, 40 long, uniform, with long ciliations. Sens. 118 long, with short inconspicuous ciliations on distal half. SB 47. Tarsus I 206 μ by 86 μ . (Adult.) | <i>T. samboni</i> Wom. |
| 3 | DS long, thick, pointed, with only a few adpressed ciliations or serrations. Length 1.2 mm. Sens. 170, SB 37. Tarsus I 237 μ by 97 μ . (Nymph.) | <i>T. signata</i> Wom. |
| | DS finer, with fine outstanding ciliations. | 4 |
| 4 | Length 1,100 μ , width 860 μ . DS 30-50 long. Sens. 160, SB 57. Tarsus I 260 μ by 105 μ . (Adult.) | <i>T. minor</i> Berl. |
| | Length 1,670 μ width. DS to 70 long. Sens. 160. SB 42. Tarsus I 275 μ by 67 μ . (Adult.) | <i>T. elegans</i> Wom. |

- 5 Sens. area transverse and wider than long.
Sens. area more or less triangular, about as long as wide. *T. akamushi* (Brumpt.)
T. palpalis Nagayo
T. pallida Nagayo*
T. intermedia Nagayo
T. scutellaris Nagayo
- 6 Sens. 111, with short cilia along whole length, those on basal third very small, SB 25. Tarsus I in ratio of width to length = 1:1.7. DS 21-56, apically knobbed. (Nymph.) *T. delicis* Walch.
Sens. 160, with few long branches on distal half. SB 71. Tarsus I 132 μ by 53 μ . DS 26-40 pointed with long outstanding ciliations. (Nymph.) *T. tindalei* Wom.

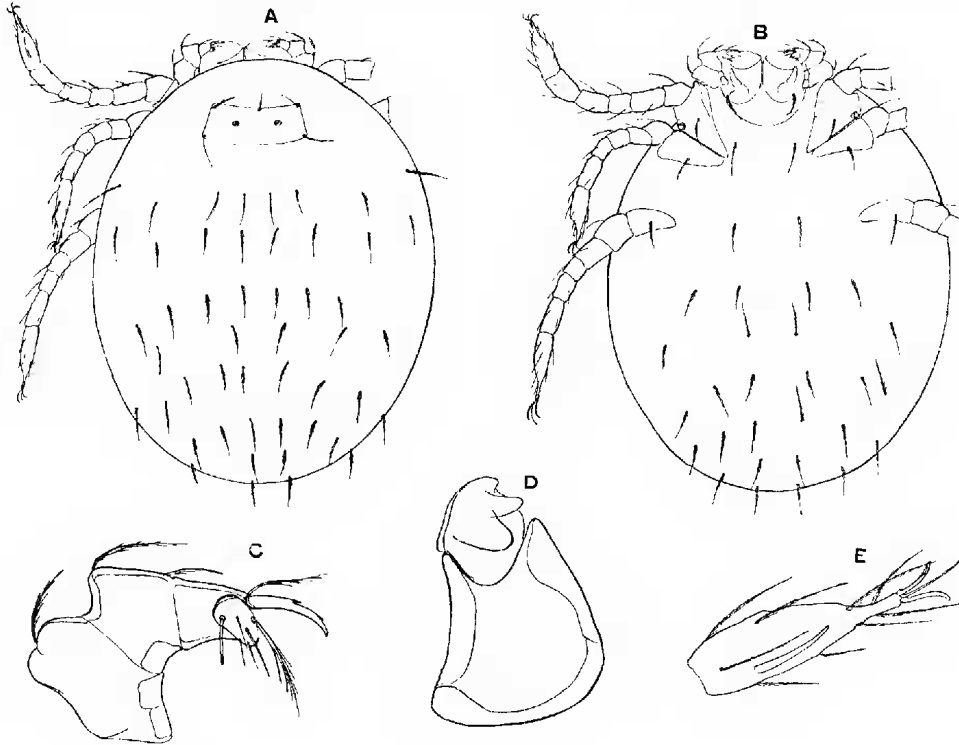
Gen. **Myotrombicula** nov.

Mandibles and palpi modified for grasping hair. One dorsal scutum as in *Trombicula*, with five normal scutal setae and a pair of sensillae. Claws three on all legs, the inner claw longer and finer than the laterals. Genotype **M. vesper-tilionis** n. sp.

Myotrombicula vesper-tilionis n. sp.

(Text fig. 6, A-E; text fig. 8, B)

Description—Shape almost rounded. Length 275 μ , width 220 μ . Legs long and slender, I 170, II 145, III 145. Dorsal scutum transversely rectangular (cf. text fig. 8, B), AW 62.5, PW 65.5, SD 24, ASB 16, PSB 11, A-P 16, AM 23, AL 19, PL 27, Sens. —, DS 23. Dorsal setae arranged 2.6(8).2(6).8.4.8.6.4.2, pointed, with short ciliations. Eyes absent. Mandibles (text fig. 6, D) with stout short stipes, and short broad chelicerae with two large blunt teeth, adapted more for



Text fig. 6

Myotrombicula vesper-tilionis n.g. et n. sp.: A, dorsal view; B, ventral view;
C, palp; D, mandible; E, tarsus I.

* See under larval form of this species.

grasping hair. Palpi as in text fig. 6, C, strongly bent over as if to help in grasping hair, details as in figure. Venter with setae as shown, one on each coxae, a pair between coxae I and between coxae III, thereafter 2.4.4.6.6.4.2. Tarsus I (text fig. 6, E) with a long stout dorsal seta.

Loc. and Hosts.—This very interesting species was found among the debris of a jar of spirit containing bats, No. M 4443-53, 3576, 501, and 500 in the collections of the South Australian Museum, probably from South Australia.



Text fig. 7

Trombiculoides gateri n. g. et n. sp.: A, dorsal view; B, ventral view; C, palp; D, chelicera; E, tarsus I.

Remarks—The modifications of the palpi and chelicerae suggest the adaptation for grasping hair, although the modifications are not as pronounced as in some genera of Listrophoridae.

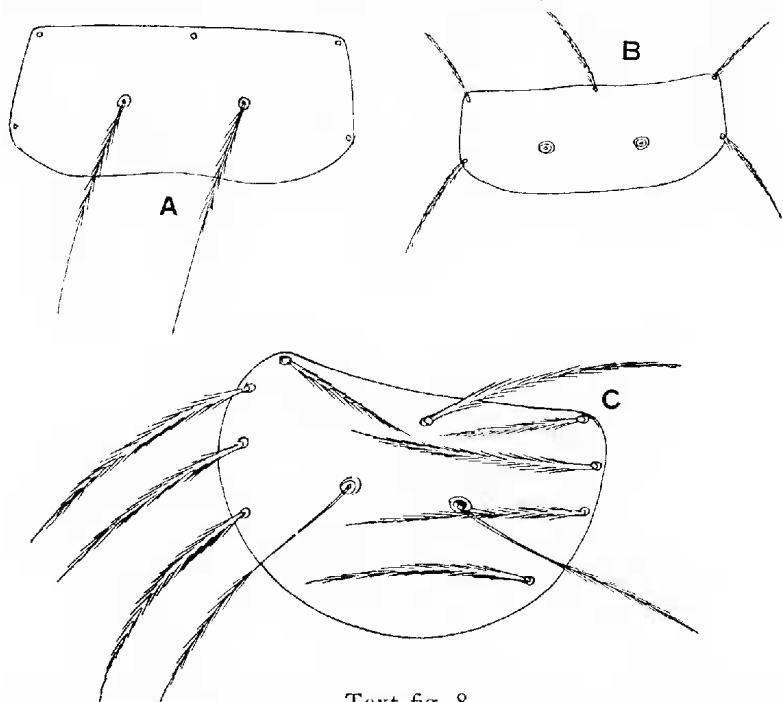
Genus **Trombiculoides** nov.

With a single dorsal scutum carrying nine normal setae and a pair of long filamentous sensillae. Eyes 2 + 2. Chelicerae large and strong with a strong apical and strong inner subapical tooth. Genotype *T. gateri* n. sp.

Trombiculoides gateri n. sp.

(Text fig. 7, A-E; 8, C)

Description—Shape subrotund. Length 690 μ , width 395 μ . Legs I 310, II 275, III 340. Eyes, two on each side. Dorsal scutum with a slightly incurved front margin, and then uniformly curved so that there is no demarcation between the lateral and posterior margins; with strongly ciliated setae, one anterior



Text fig. 8

A, dorsal scutum of *Trombicula corvi* K. & Y., x 500; B, dorsal scutum of **Myotrombicula vespertilionis** n. sp., x 500; C, dorsal scutum of **Trombiculoides gateri**, n. sp., x 500

median, one at each antero-lateral corner and one where each postero-lateral corner should be, and then two on each side between the AL and PL setae; two long sensillary setae, ciliated on apical half, their bases slightly in advance of the middle of scutum. Mandibles large and strong, with large prominent apical and inner subapical teeth. Dorsal setae long, 80, pointed and strongly ciliated in rows of 2.12.8.4.2.8.10.10.6.4, rows four and five from front with the setae sublateral. Palpi normal as figured, tibial claw bifurcate. Venter; all coxae with a single ciliated seta, a pair of setae between coxae II and between coxae III, thereafter 11.6.11.8.6.4.2.2, gradually lengthening posteriorly. Tarsi with three claws, the middle one about twice as long as laterals, tarsus I as in text fig. 7, E, tarsus III with a long outer simple seta. Standard data as follows:

AW	AW ¹	AW ²	PW	Max. W	SB	ASB	PSB	A-P	AN	AL	AL ¹	AL ²	PL	Sens.
76	91	85	78	95	27	27	33	42	65	28	38	70	60	75

(N.B.—AL₁ and AL₂ are the second and third lateral scutal setae, and AW¹ and AW² the width of the scutum between these; Max. W is the greatest width of the scutum.)

Loc. and Hosts—The type and two paratypes from *R. rattus argentiventer* Chase from Selinsing-Gunong, Semanggel. Perak, 15/3/32, were sent to us for study by the Institute for Medical Research, Federated Malay States.

Remarks—This genus, in the peculiar and strong chelicerae and the extra scutal setae, is obviously distinct from its allies. In the latter character it might show some relationship to *Gahrlepiea* and its associates, but from a study of the figures it is clear that the extra scutal setae are not homologous with the extra scutal ones in *Gahrlepiea*; they do not belong to the dorsal rows and are not taken into the scutum by any posterior prolongation.

Genus SCHÖNGASTIA Oudemans 1910

Entom. Ber., 3, (54), 86. Genotype *Trombidium vandersandei* Oudms. 1905; *ibid.* 1, (22), 216.

Trombiculinae with the sensillary setae of the single anterior dorsal scutum clavate or capitate. Dorsal scutum more or less rectangular and with five setae besides the sensillary setae, 1 AM, 2 AL and 2 PL. Chelicerae dorsally serrated.

Only the larval stages of this genus are as yet known.

KEY TO THE MALAYAN, NEW GUINEA AND FORMOSAN SPECIES OF SCHÖNGASTIA

- | | | | |
|---|--|---|---|
| 1 | Dorsal scutum roughly rectangular, posterior margin sinuous. PL much the shortest
17. AM the longest, DS 2.6.6.6.6.2. | <i>S. oudemansi</i> Walch 1923 | |
| | Dorsal scutum roughly pentagonal or hexagonal | | 2 |
| 2 | Dorsal scutum roughly pentagonal PL the longest, AM the shortest, DS 2.10.6.6.4.2. | <i>S. victa</i> Gater 1932 | |
| | Dorsal scutum roughly hexagonal. | | 3 |
| 3 | AL shorter than AM or PL, DS 2.12.8.4.6.4.2.2, Sens. nude. | <i>S. jamesi</i> Gunther 1939 | |
| | AL longer than AM, or PL, or both. | | 4 |
| 4 | Sens. in line of PL. | | 5 |
| | Sens. well behind line of PL. | | 6 |
| 5 | AW 58, PW 72, DS 2.8.10.10.8.8.4 (after Kawamura). | S. katonis n.sp. | |
| | AW 66, PW 91, SB 26, DS 2.10.8.10.8(10).8.8. | <i>S. blestowei</i> Gunther 1940 | |
| | AW 59, PW 80, SB 33, DS 2.10.2.10.2.10.8.6.4.2. | <i>S. blestowei</i> v. megapodius nov. | |
| 6 | DS 2.10.2.10.2.14.2.10.12.8.4., Sens. 35, nude. | <i>S. taylori</i> Gunther 1940 | |
| | DS 2.10.10.10.10.8.2. Sens. 25 | <i>S. vandersandei</i> Oudms. 1905 | |

SCHÖNGASTIA OUDEMANSI (Walch 1923)

Trombicula oudemansi Walch, Kitasato Archiv. Exper. Med., 5, (3), 1923; Fletcher, Lesslar and Lewthwaite, Trans. Roy. Soc., Trop. Med. and Hyg., 22, 161, 1928.

Schöngastia oudemansi (Walch). Gater 1932. Parasitol., 24.

(Pl. vi, fig. 1)

This species is apparently not known to attack man. It was described from Deli, Sumatra, by Walch from rats, and in 1928 Fletcher et. al. record it as the commonest mite on rats in the Federated Malay States.

We have not seen any specimens of this species but from the data and figures given by Walch and by Fletcher we have drawn the scutum to scale, and deduced the following standard data. Otherwise, the key will separate this species from others of the genus.

Walch's data are: scutal length 50, width 72. AL 27, PL 16.6 and 12 behind sensillae. Sensillae 30 x 9. DS 22 long and arranged in his figure 2.6.6.6.4.4.2. Fletcher furnishes a figure agreeing with that of Walch.

From the above the standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.
50	68	34	26	24	40	40	27	17	39 x 9

SCHÖNGASTIA VIETA Gater 1932

Parasitology 1902, 24, 143-174, fig. 5.

(Pl. vi, fig. 2)

Gater described this species from the ears of *R. rattus diardi* (Jentink) from Kuala Lumpur, Selangor, Federated Malay States, and also recorded it from *R. r. jalorensis* from the same locality and from *R. mulleri validus* from Raub, Pahang.

We have been able to examine one of the series from Raub, and the drawing to scale of the scutum and the following standard data are from that specimen:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
55	78	20	21.5	30	30	25	50	58	35 x 13	45

Dorsal setae 2.10.6.6.4.4.2. Gater gives the scutal length as 56 and the width 76.

SCHÖNGASTIA JAMESI Gunther 1939

Schöngastia rotunda Gunther 1938, Med. J. Austr., 2, (6), 202 (*nom. nud.*); *jamesi* Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 91.

(Pl. vi, fig. 3)

Through the kindness of Prof. Harvey Sutton of the School of Public Health and Tropical Medicine, University of Sydney, we have been able to examine Gunther's type slide which is labelled "Type specimens XI *S. rotunda* (*jamesi*) Bulolo, T. N. G." There are two specimens on this slide, but only one of these, and that one much damaged by pressure, is *S. jamesi* Gunther; the other specimen is *T. hirsti* v. *deliensis* Walch (= *buloloensis* Gunther). From the type specimen we have only been able to determine SB 35, ASB 26.5, A-P 30, AM 43 +, AL 40, PL 63.

Gunther gives scutal length 50, width 85. AM broken. AL 37.5, PL 47, SB 37, Sens. 37.5 x 12.5, apparently naked. DS 2.12.8.4.6.4.2.2. The figure of the scutum given here is drawn to scale from the above data.

SCHÖNGASTIA BLESTOWEI Gunther 1939

Schöngastia yeomansi Gunther 1938, Med. J. Austr., 2, (6), 202 (*nom. nud.*); *blestowei* Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 92.

(Pl. vi, fig. 4, 5)

Gunther described this species from a number of specimens from two men near the Sucin River, Sepik District of New Guinea. He also recorded it at the same time from the ears of bush fowl (*Megapodius duperreyi*) from the Bulolo River basin, Morobe District, and from a man at Bulolo.

We have been privileged to examine the type slide from the School of Medicine, Sydney University. This slide contained 10 specimens of the collection

from Suen River, two of which were indicated as types. Seven of these specimens have been carefully measured for our standard data as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 65	91	26	34	31	29	37	65	52	35 x 15	35-40
"	- 65	90	26	31.5	27	31	35	65	50	35 x 15	35-40
Parat.	- 65	91	26	31	29	30	35	65	50	35 x 15	35-40
"	- 65	91	26	31	29	30	40	65	50	35 x 15	35-40
"	- 65	88	26	31	29	29	—	65	52	35 x 15	35-40
"	- 65	87	24	31	29	30	35	65	52	35 x 15	35-40
"	- 65	87	26	31	29	31	35	65	50	35 x 15	35-40
Mean	- 65	89	26	31.5	29	30	36	65	51	35 x 15	35-40

Dorsal setae arranged 2.10.2.8.10.10.8.8.

Gunther gives the following: scutal length 62.5, width 94, AM 37.5, AL 75, PL 50, SB 25, Sens. 37 x 15, and DS 2.10.8.108(10).10(8).8.8. A slide of three paratypes from *Megapodius duperreyi* from Bulolo, T. N. G., is in the South Australian Museum Collection. The standard data of these specimens are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
	58	78	32	28	24	20	37	63	58	30 x 15	50
	60	82	35	28	24	20	—	—	62	30 x 16	50
	59	80	32	26	26	20	—	—	—	—	—
Mean	- 49	80	33	27	25	20	37	63	60	30 x 15	50

Arrangement of dorsal setae, 2.10.2.10.2.10.8.6.4.2.

It will be seen that there are marked differences in the data of the two lots of specimens, those from *Megapodius* having a smaller scutum with the SB wider apart and placed well behind the line of PL. A-P is also shorter than in the specimens from man, while the DS are also longer. These differences, however, may not be more than varietal and for the present we can only regard them as such and name the form as *S. blestowei* v. **megapodius** nov. The drawings to scale of the dorsal scuta are from the above series of data.

In addition, the scuta in the typical *blestowei* from man is strongly pitted and there is a well-developed crest from the wall of which arises the sensillae. In the specimens from *Megapodius* we cannot see a crest nor any pitting. In the presence of a crest and pitted scutum the typical form might fit into *Paraschön-gastia*, but the serrate chelicerae and the absence of circular striations on the posterior portion of the scutum exclude it.

Schongastia katonis n. sp.

(Pl. vi, fig. 5)

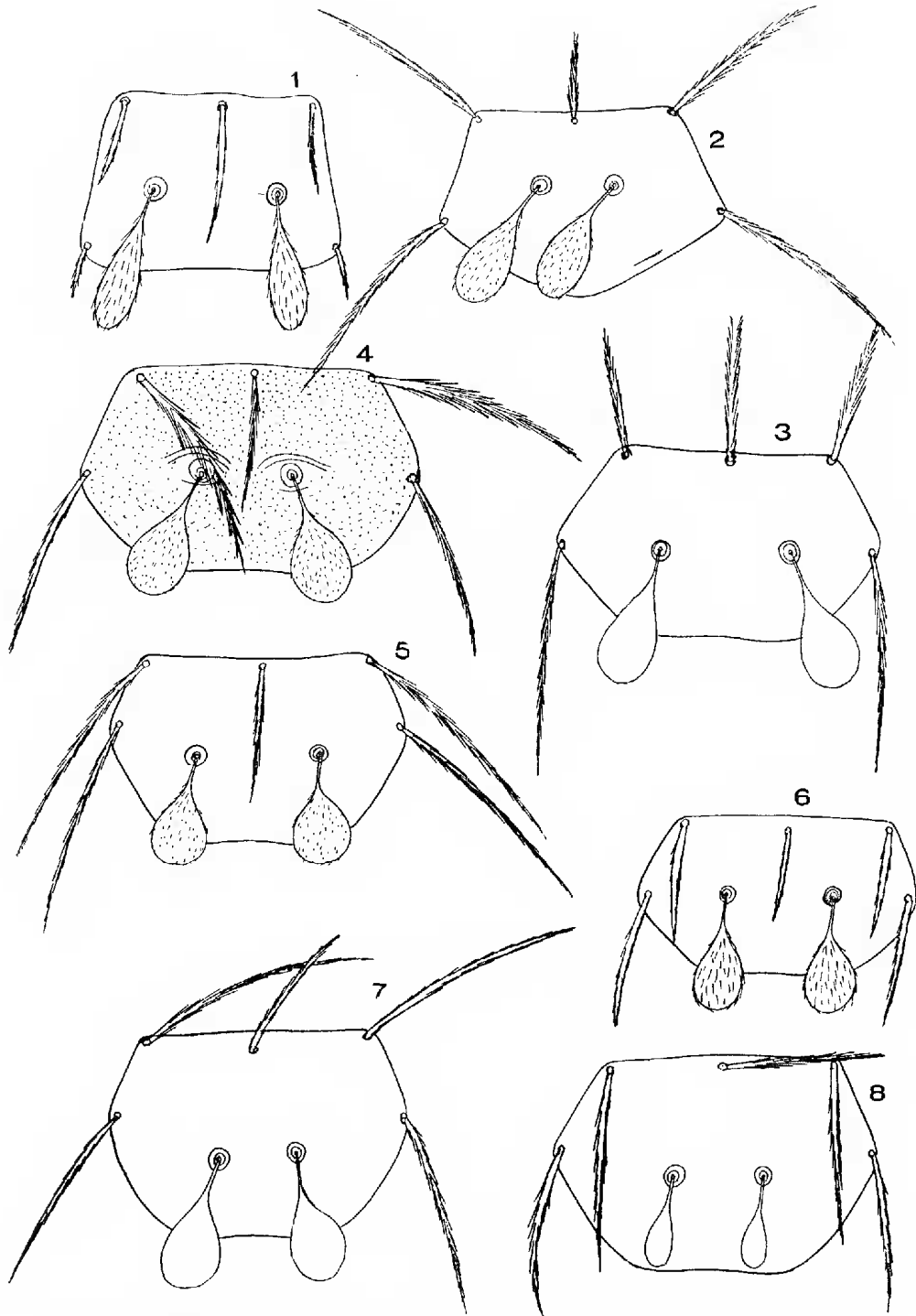
In 1921 Kawamura, R., and Yagamuchi, M. (Kitasato Archives Exper. Med., IV), described a specimen received from Y. Kato in 1917, from Parao Island, in the Carolines. Although well described and figured, they did not give a name to the species, so that *katonis* is here proposed.

Kawamura and Yamaguchi give the following details, from which our standard data and drawing of the scutum are compiled.

Front edge of scutum 58, width 72.6, length 43.6. Sens. clavate, club 20.3 long, 17.4 broad. DS 30-40, arranged 2.8.10.10.8.8.4. Chelicerae serrate.

Standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
55	68	28	22	21.5	21	23	37	40	31 x 17	30-40



1, *Schöngastia oudemansi* (Walch); 2, *S. vieta* Gater; 3, *S. jamesi* Gunther;
 4, *S. blestowei* Gunther; 5, *S. blestowei* v. **megapodius** nov.; 6, ***S. katonis*** n. sp.
 7, *S. taylori* Gunther; 8, *S. vandersandei* Oudms.

SCHÖNGASTIA TAYLORI Gunther 1940

Proc. Linn Soc. N.S.W., 1940, 65, (3-4), 257, fig. 12-14.

(Pl. vi, fig. 6, 7)

Described from colonies on the scrotum and hind legs of a scrub wallaby (*Macropus (Thylogale) coreni* Gray) at Bulolo, T. N. G.

Of this species we have examined the type slide containing two paratypes in addition to the type, and another slide of two paratypes. From these our standard data are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 61.5	79	21	35	23.5	23.5	40	73	55	35 x 15	40-50
Parat.	- 63	79	21	35	23.5	23.5	—	78	—	—	40-50
„	- 61.5	79	21	35	23.5	23.5	43	78	55	—	40-50
„	- 63	79	22	35	23.5	23.5	40	81	58	—	40-50
„	- 63	79	21	35	23.5	23.5	41	78	60	—	40-50
Mean	- 62.5	79	21	35	23.5	23.5	41	78	57	35 x 15	40-50

Arrangement of dorsal setae, 2.10.2.12.2.14.2.10.12.8.4.

Gunther gives the following details: scutal width 87, length 57, AM 42, AL 56, PL 63, Sens. 37.5-15, probably naked. N.B.—It seems possible that his measurements of AL and PL have been reversed, for they do not agree with our measurements of the type.)

SCHÖNGASTIA VANDERSANDEI (Oudemans, 1905)

Thrombidium van der Sandei Oudemans, 1905, Ent. Berichten, 1, (22), 216; 1906, Nova Guinea, V, Zool., 131.

Microthrombidium vandersandei Oudemans, 1909, Ent. Bericht., 3, (50), 21.

Schöngastia vandersandei Oudemans, 1912, Zool. Jahrb., Suppl. 14, 45.

(Pl. vi, fig. 8)

This species, which is the type of Oudemans genus *Schöngastia*, was described from New Guinea as attacking man. Oudemans 1906 (*loc. cit.*) gives many records from travellers in this region of being attacked by these small mites. As so many other species of Trombiculinae are now known to occur in New Guinea, it is extremely doubtful whether all these records should be listed under this one species as Oudemans has done; they probably include many species.

From the figure and brief details given by Oudemans we have constructed the scale drawing of the scutum and the following approximate data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
60	85	25	35	27.5	27.5	45	60	50	25 x 9	40

Dorsal setae, 2.10.10.10.10.8.2.

Genus NEOSCHÖNGASTIA Ewing 1929

Manual of External Parasites 1929, 187. Genotype *Schöngastia americana* Hirst 1921, Ann. Mag. Nat. Hist., (9), 7, 37.

This genus was erected for those species of *Schöngastia* in which the chelicerae are without dorsal serrations. As yet it is only known from the larvae, with the doubtful exception of *Neoschöngastia schüffneri* Walch, which Walch claims to have reared through to the nymph, of which he figures the crista. From his figure, however, it can hardly be differentiated from *Trombicula* spp., and has the same kind of long, fine, filamentous sensillae, with minute ciliations. Walch also figured the dorsal setae and the palp of the nymph, but here again no differences from *Trombicula* are evident.

In this paper 34 species and 1 variety are recognised, of which 9 species and 1 variety are new.

KEY TO THE MALAYAN, AUSTRALIAN AND JAPANESE SPECIES
OF NEOSCHÖNGASTIA

- | | | |
|----|---|----------|
| 1 | Sensillae capitate or globose.
Sensillae clavate, often broadly so. | 2
13 |
| 2 | Sensillae nude.
Sensillae with obvious, though sometimes minute setules. | 3
5 |
| 3 | AL longer than PL, PL shorter than PW, DS 2, 6.6.6.4.2. N. innisfailensis n. sp.
PL much longer than AL and PW. | 4 |
| 4 | PL about twice the length of PW, DS 2.6.6.6.2(4).4(2).2 <i>N. womersleyi</i> Gunther 1940
PL only slightly longer than PW, DS 2.6.6.6.6.2(4).2. N. melomys n. sp. | 6
7 |
| 5 | Coxae III multisetose.
Coxae III unisetose. | 6
7 |
| 6 | Coxae III with two setae. DS 2 plus ca. 10 rows of 10 each. Scutal setae with long ciliations. <i>N. petrogale</i> Wom. 1934
Coxae III with 3-5 setae. Scutal setae with short ciliations. DS 2.8.6.6.8.2.4.2.2. <i>N. mutabilis</i> Gater 1932 | 8
9 |
| 7 | PL and most of DS foliate or lanceolate and shortly ciliated.
Scutal and DS normal. | 8
9 |
| 8 | PL and first four rows of DS foliate. PL much longer than PW. DS 2.6.6.6.6.4.2. <i>N. foliata</i> Gunther 1940
AM, PL and all DS except posterior two lanceolate. Sensillae? Scutum rectangular. PL much shorter than PW, DS 2.8.6.6.4.2. <i>N. hastata</i> (Gater 1932) | 10
11 |
| 9 | First row of DS with four setae, <i>i.e.</i> , DS 4.6.6.6.6.4.2. Sensillae in front of PL. AL longer than PL. <i>N. queenslandica</i> Wom. 1939
First row of DS with two setae only. | 10 |
| 10 | Scutum roughly hexagonal. DS 2.14.14.10.12.8.4. <i>N. edwardsi</i> Gunther 1939
Scutum not so. | 11 |
| 11 | Scutum almost rectangular; posterior margin only slightly sinuous and extending very little behind PL. DS 2.6.8.8.8.8.6.4.2. (After Hirst) or 2.4.8.10.10.8. plus about 14. <i>N. antipodianum</i> Hirst 1929
Scutum not rectangular; posterior margin extending well behind PL. | 12 |
| 12 | Posterior margin of scutum shallowly sinuous medially. Sensillae anterior of PL. DS 2.6.6.6.6.4.2. <i>N. coorongensis</i> Hirst 1929
Posterior margin of scutum an even curve. Sensillae behind PL. DS 2.8.6.6.6.6.4.2. (After Walch.) <i>N. globulare</i> Walch, 1927 | 14
15 |
| 13 | Sensillae long and narrow, almost lanceolate rather than clavate.
Sensillae definitely clavate with more or less of a basal stem. | 14
15 |
| 14 | PL longer than AL or AM. PL off scutum. Scutum small, 34 long, 50 wide. DS 0.8.6.6.4.2. (After Gater.) <i>N. malayensis</i> Gater 1932
PL shorter than AL or AM, definitely on the scutum. Scutum larger, 55 long, 78 wide. DS 2.6.8.8.6.6.4.2. (After Gater.) <i>N. lacunosa</i> Gater 1932 | 16
18 |
| 15 | AL much longer than PL.
AL shorter than PL. | 16
18 |
| 16 | PL the shortest, 13-14. DS 2.6.6.4(6).6(4).4.2. <i>N. impar</i> Gunther 1939
= <i>bodensis</i> Gunther 1940
PL more than 40 and longer than AM. | 17 |
| 17 | Posterior margin of scutum medially concave. Sensillae in line of PL and in midline of scutum. DS 2.8.10.8.8.6. (After Walch.) <i>N. schüffneri</i> Walch 1923
Posterior margin of scutum a shallow even curve. Sensillae well in advance of PL. PL well behind midline of scutum. DS 2.8.6.6.4.2. <i>N. pseudoschüffneri</i> Walch 1927 | 17 |

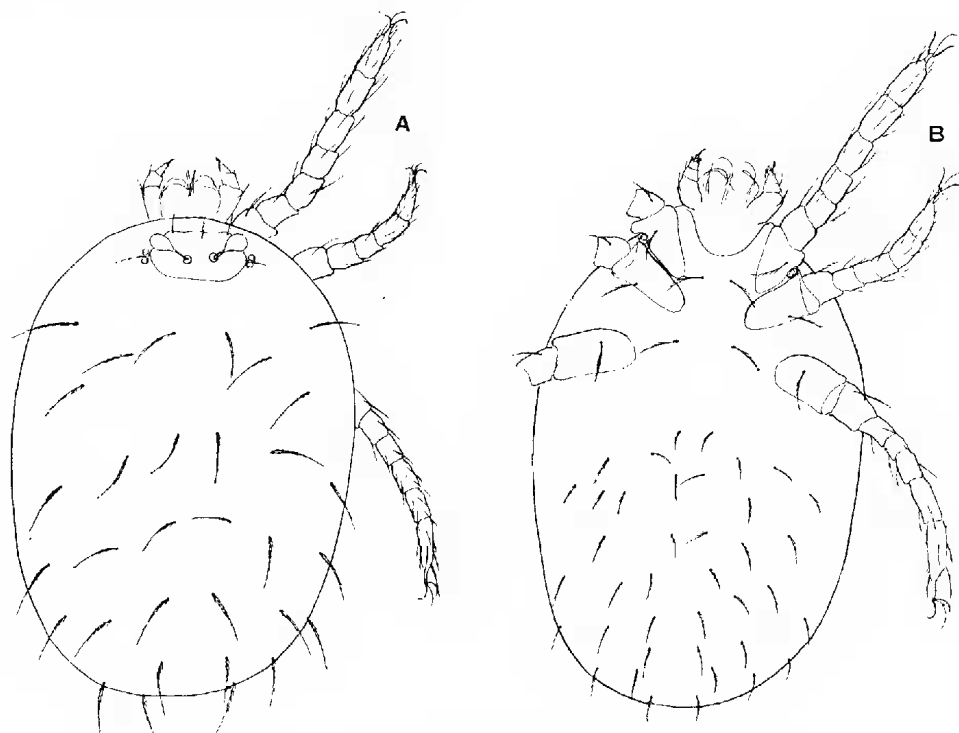
- 18 AW less than 40. 19
 AW greater than 50. 22
- 19 First row of DS with four setae, *i.e.*, DS 4.6.6.6.4.2. AW 35. *N. indica* Hirst 1915
 = *muris* Walch 1923
 First row of DS with only two setae 20
- 20 Scutum almost rectangular, and posterior margin rectilinear. Sensillae? DS
 2.12.4.8.7.10.2.5.4 (after Gater). *N. debilis* Gater 1932
 Not so. 21
- 21 PL about in midline of scutum. AM and PL nearly equal. Sensillae slightly in front
 of midline of scutum. DS 2.6(2,4).4.2.4.2.16.12. *N. lorius* Gunther 1939
 PL well behind midline of scutum, longer than AM. DS 2.6.6.4.2. **N. rattus** n. sp. 22
- 22 DS on small platelets, 2.6.2.6.8.6.4.8.6.4.2. **N. heaslipi** n. sp. 23
 DS not on platelets. 23
- 23 Sensillae posterior to, or in line of, PL. AW/A-P greater than 2·7. 24
 Sensillae anterior to line of PL. AW/A-P less than 2·7. 31
- 24 PL midway between anterior and posterior corners of scutum, which is roughly
 trapezoidal with broadly rounded posterior corners. DS 2.12.12.12.12. plus about 30.
N. perameles Wom. 1939
 Not so. PL at the posterior angles of scutum. Posterior margin evenly curved or
 sinuous. 25
- 25 A-P half SD. DS 2.8.6.6.6.4.2 26
 A-P distinctly less than half SD. 27
- 26 AW 84, PW 101, SD 52. *N. australiensis* Wom. 1934
 AW 63, PW 84, SD 58. *N. trichosuri* Wom. 1939
- 27 PL shorter than PW. 28
 PL equal to or longer than PW. 30
- 28 Posterior margin of scutum an even curve. DS 2.8.6.6.6.2.2. AM 39, AL 22, PL 46.
 PW 65. *N. dasycerci* Hirst 1929
 Posterior margin sinuous. 29
- 29 AL longer than AM. AM 37·5, AL 45, PL 56, DS 2.8.6.6.6.4.2.
N. shieldsi Gunther 1941
 AL shorter than AM AM 47, AL 27·5, PL 72, DS 2.8.6.6.6.4.2. **N. hirsti** n. sp.
- 30 DS 2.4.4.4.2. **N. similis** n. sp.
 DS 2.6.6.6.4.2. *N. derricki* Wom. 1939
- 31 DS 2.6.6. plus. 33
 DS not so. 32
- 32 DS 2.12.12.12.12.10.8.4.2. **N. guntheri** n. sp.
 DS 2.8.8.8.8.6.4.2. *N. smithi* Wom. 1939
- 33 AW about 11 less than PW. DS 2.6.6.6.6.6.4.2. **N. phascogale** n. sp.
 AW at least 20 less than PW. DS 2.6.6.6.6.4.2. 34
- 34 AW 54, PW 75. **N. cairnsensis** n. sp.
 AW 70, PW 97. *N. cairnsensis* v. *gateri* nov.

Neoschongastia innisfailensis n. sp.

(Pl. vii, fig. 1; text fig. 9, A-B)

Description—Shape elliptical, with rather flattened sides. Length 365 μ , width 225 μ . Legs: I 210, II 170, III 225. Mandibles with non-serrate chelae. Palpi normal, with trifurcate tibial claw. Dorsal scutum as in pl. vii, fig. 1, with the following standard data: AW 42·5, PW 65, SB 18, ASB 23, PSB 16, A-P 26.

AM 32, AL 51, PL 44.5, Sens. 31, with globose head 16 wide and with only very indistinct ciliations under high magnification, almost nude. Eyes two on each side, closely adjacent to scutum. Dorsal setae 25 to 45 long, arranged 2.6.6.6.4.2, finely ciliated and tapering. Ventrally with shorter setae, arranged as in text fig. 9B. Legs with normal chaetotaxy; tarsi with two strong claws and a longer median pulvillus somewhat claw-like.



Text fig. 9

Neoschongastia innisfailensis n. sp.: A, dorsal; B, ventral.

Loc. and Hosts—Fifteen specimens from *Macromys littoralis* Lonnberg from Innisfail, Queensland, 12 October 1938 (W. G. Heaslip).

Remarks—Of ten of the specimens measured the average standard data are as given above, and the highest and lowest values as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL
Highest	- 48	78	22	25	21	27	40	56	51
Lowest	- 40	60	13	21	13	24	24	45	43

There are much greater variations in the standard data of individuals within this species than is usual.

NEOSCHÖNGASTIA WOMERSLEYI Gunther 1940

Proc. Linn. Soc. N.S.W., 65, (3-4), 254, 1940.

(Pl. vii, fig. 2)

This species was described by Gunther from colonies in the ears of *Macropus (Thylogale) coxeni* Gray 1866 from Bulolo, T. N. G., November 1939.

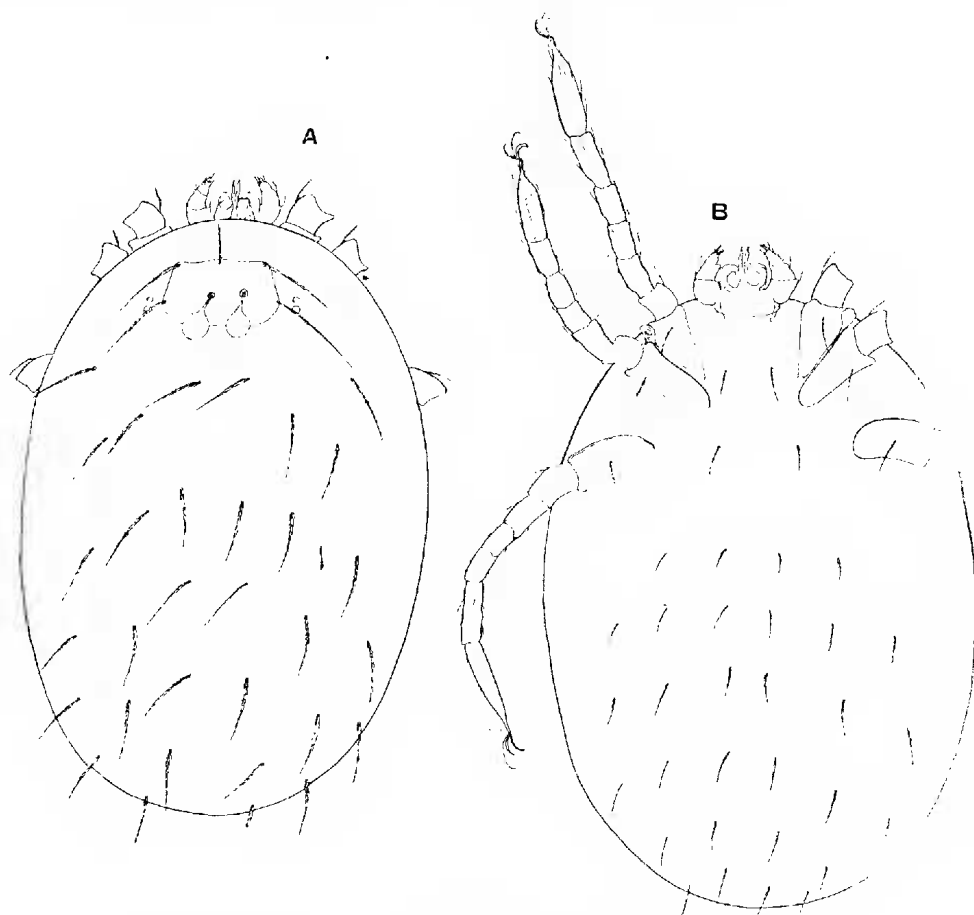
We have been able to examine the type slide containing, besides the type, seven paratypes, of which the type and three others have been measured. In addition, we have also examined a slide containing two paratypes of which one was mea-

sured, and a slide of nine paratypes of which three have been measured. Our standard data for those measured are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
Slide 1, Type & 7 Parat.	- 41.5	63	15	23	16.5	27	—	—	115	—	40-50	
" " "	- 43	63	15	22	18	25	35	69	130	—	40-50	
" " "	- 43	63	15	22	16.5	28	35	69	130	—	40-50	
" " "	- 43	65	18	25	16	28	—	66	130	—	40-50	
Slide 2, 2 Parat.	- - -	41.5	63	17	—	—	—	36	66.5	130	—	40-50
Slide 3, 9 Parat.	- - -	45	68	16.5	23	15	30	36	75	—	—	40-50
" " "	- - -	43	61.5	15	23	18	30	36.5	76.5	140	30 x 16	40-50
" " "	- - -	41.5	61.5	15	23	18	28	35	76.5	130	—	40-50
Mean	- - - - -	43	63.5	16	23	17	28	36	71	130	30 x 16	40-50

Dorsal setae arranged 2.6.6.6.2(4).4(2).2.

Gunther's data are as follows: AW 50, PW 75, SB 19, ASB 25, PSB 14, A-P 32, AM 36, AL 60-70, PL 120-140, Sens. 30 x 14, DS 54.



Text fig. 10

Neoschongastia melomys n. sp.: A, dorsal, B, ventral.

Neoschongastia melomys n. sp.

(Pl. vii, fig. 3; text fig. 10, A-B)

Description—Shape elliptical with the sides rather flattened. Length 465 μ , width 260 μ . Legs: I 220, II 190, III 220. Mandibles with non-serrate chelae.

Palpi normal, with trifurcate tibial claw. Dorsal scutum as in pl. vii, fig. 3, with the following standard data: AW 51, PW 67, SB 17, ASB 21.5, PSB 16, A-P 26.5, AM 31.5, AL 63, PL 72. Sens. 30, with globose head 16 wide, and apparently nude. Eyes 2 + 2, rather small. Dorsal setae 30-55 long, pointed and shortly ciliated, arranged 2.6.6.6.2(4).2. Ventrally with shorter setae, one on each coxa, a pair between coxae I and between coxae III, thereafter arranged 4.6.6.6.4.4, their length gradually increasing posteriorly. Legs with normal chaetotaxy, tarsi furnished with two claws and a median longer claw-like pulvillus, tarsi I and II with a median dorsal rather short stout sensory rod, as normally.

Loc. and Hosts—The type from the ears of *Melomys littoralis* Lombg., Innisfail, Queensland, October 1938 (W. G. H.), and 15 other specimens from rats at Cairns, Queensland, in 1939 and 1940 (W. G. H.).

Remarks—Of these 16 specimens the mean standard data are as given above, and the highest and lowest as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL
Highest	54	70	20	22	19	27	32	67	76
Lowest	46	62	16	19	13	24	27	57	70

NEOSCHÖNGASTIA PETROGALE Woml. 1934

Rec. S. Aust. Mus., 5, (2), 215, 1934.

(Pl. vii, fig. 4)

This species was described from specimens taken from the scrotum of a wallaby in the Musgrave Ranges, South Australia.

The standard data for eleven specimens are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
	65	85	31	24	24	32	39	48	52	31 x 17	30-48
	64	86	27	24	24	32	39	46	46	—	30-48
	63	84	30	24	24	28	38	48	48	30 x 16	30-48
	61	81	23	23	23	30	39	44	48	—	30-45
	61	80	23	—	25	30	—	—	50	—	30-46
	65	82	28	25	24	30	40	46	50	—	30-50
	65	85	24	26	23	31	39	49	46	27 x 17	30-46
	66	84	27	26	24	30	—	—	47	30 x 17	30-46
	63	88	30	27	23	32	39	47	48	32 x 17	30-47
	65	88	28	27	22	31	38	47	50	31 x 17	30-50
	66	85	31	29	23	30	40	48	50	30 x 17	30-47
Mean	64	84	27.5	25	24	31.5	39	47	49	30 x 17	30-47

NEOSCHÖNGASTIA MUTABILIS Gater 1932

Parasitology, 24, 143-174, 1932.

(Pl. vii, fig. 5)

This species was described by Gater, but without any figure, from a cluster of mites in the ear of *Rattus sabanus vociferans* (Miller), from Sungei Buloh, Selangor, Federated Malay States.

We have been able to examine a mount of a somewhat imperfect specimen, labelled by Gater as this species, from *Tupaia glis ferruginea* Raffles from the same locality as the type material.

Standard data for this specimen, and from which the figure of the scutum given here is constructed, are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
43	60	8.5	23	12.5	28	—	28	53	28 x 15	35-42

DS arranged 2.8.6.6.8.2.4.2.2.

Gater gives the following: scutal width 72, length 45, SB 12, AL usually the longest, DS 42. These data differ considerably from those of the specimen examined.

NEOSCHÖNGASTIA FOLIATA Gunther 1940

Proc. Linn. Soc. N.S.W., 65, (3-4), 255, 1940.

(Pl. vii, fig. 6)

This species was described from colonies in the ears of *Macropus (Thylgale) coreni* Gray, for Bulolo, T. N. G.

We have been able to measure the standard data for five paratypes of Gunther's material with the following results:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
	50	71	16.5	20	18	25	20	—	91	28 x 17	50-60
	53	68	16.5	20	16.5	25	18	58	83	—	50-60
	50	68	16.5	18.5	16.5	25	21	55	90	—	50-60
	55	71	18	18	17	25	20	63	86	28 x 17	—
	58	70	18	20	18	25	24	—	83	—	50-60
Mean	53	70	17.5	19.5	17.5	25	20.5	57	86	28 x 17	50-60

Dorsal setae arranged 2.6.6.6.4.2.

Gunther's data are: scutal length 47, width 84, Sens. bases 19 apart, AM 19-25, AL 50-56, PL 80-100, Sens. 28 long, with club 15 x 16, DS 50-62.5. From his figure we derived the following standard data: AW 66, PW 78, SB 19, ASB 24.5, PSB 27, AM 19.5, AL 57, PL 93. These agree fairly well with our measurements, except that the AW and PW are somewhat higher in proportion. As Gunther states, the PL and first four rows of dorsal setae are foliate, but in our view not so much so as drawn by him.

NEOSCHÖNGASTIA QUEENSLANDICA Wom. 1939

Trans. Roy. Soc. S. Aust., 63, (2), 162, 1939.

(Pl. vii, fig. 7)

This species was originally described from *Rattus assimilis* from Imbil, Queensland, from *R. youngi* from Cowan Cowan, Queensland, and from *Melomys cervenipes* and *R. lutreolus* from Imbil.

The following are the standard data from 12 of the above specimens:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
	51	75	21	27	14	32	—	—	55	27 x 16	32-45
	51	74	24	27	14	31	35	50	54	—	32-40
	51	73	21	27	14	32	35	48	56	30 x 16	36-40
	51	73	21	27	14	35	32	48	56	26 x 16	30-40
	51	75	26	27	14	35	35	—	54	—	35-45
	51	73	21	27	14	38	32	—	—	28 x 16	30-45
	54	80	25	27	14	35	35	50	56	—	30-45
	54	76	24	24	13	32	35	54	52	32 x 16	27-40
	49	70	24	27	13	30	32	54	52	—	29-40
	51	75	24	27	13	32	32	50	54	—	27-43
	49	70	22	24	—	30	30	54	52	32 x 16	27-40
	49	73	24	24	16	40	30	56	54	30 x 16	27-36
Mean	51	74	24	26	14	32.5	32.5	56	53	31 x 16	27-45

Arrangement of dorsal setae, 4.6.6.6.4.2.

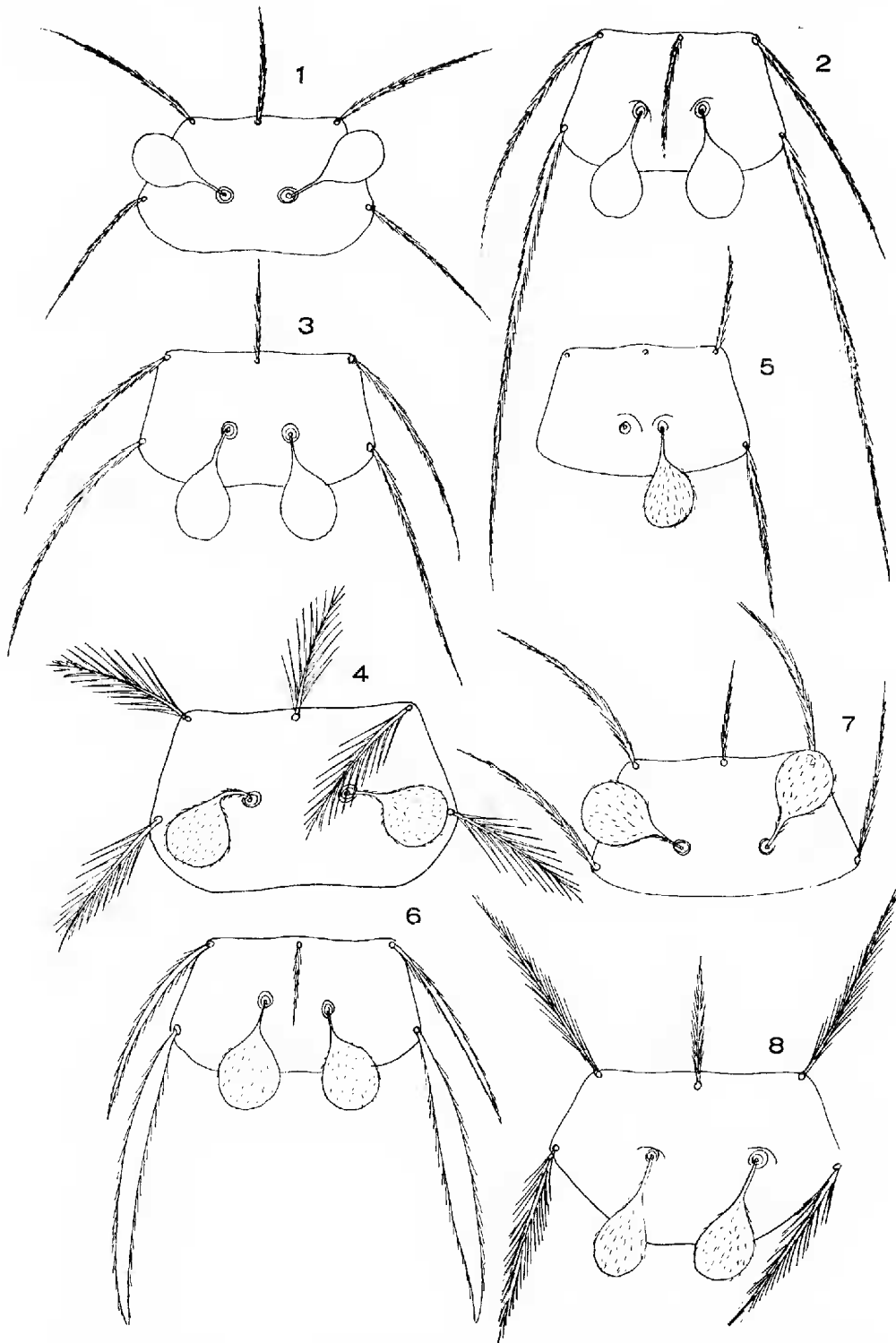
NEOSCHÖNGASTIA EDWARDSI Gunther 1939

Neoschöngastia rioi Gunther 1938 (*nom. nud.*), Med. J. Aust., 2, (6), 202.

Neoschöngastia edwardsi Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 86.

(Pl. vii, fig. 8)

This species was described from a number of specimens from the New Guinea bush fowl, *Megapodius duperreyi*.



1, *Neoschongastia innisfailensis* n. sp.; 2, *N. womersleyi* Gunther; 3, *N. melomys* n. sp.; 4, *N. petrogale* Wom.; 5, *N. mutabilis* Gater; 6, *N. foliata* Gunther; 7, *N. queenslandica* Wom.; 8, *N. edwardsi* Gunther.

We have been able to examine the type of this species, and have measured the data as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
60	81	33	28	23	28	—	58	—	35-15	40-50

The dorsal setae are arranged, 2.14.14.10.12.8.4.

Gunther gives the scutal length 56, width 87.5, and sensillae bases 36 apart, AM 37.5, AL 75, PL 60, Sens. 29 x 15.

The figure on pl. vii, fig. 8, of the scutum is to scale from the above data.

NEOSCHÖNGASTIA ANTIPODIANUM (Hirst 1929)

Schöngastia antipodianum Hirst, Proc. Zool. Soc. London, 1921, (1), 175.

(Pl. viii, fig. 1)

This species was described by Hirst from the ears of *Rattus greyi* from D'Estree Bay, Kangaroo Island, South Australia.

From the syntype material in the South Australian Museum we have made the following measurements of standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
60	70	24	29	22	42	36	65	62	29 x 19	40-55
62	67	25	32	20	42	38	69	65	—	40-60
58	66	24	29	20	42	37	69	62	25 x 17	40-60
60	67	24	27	17	40	35	70	65	28 x 17	40-58
57	67	24	29	20	40	35	70	62	28 x 18	40-58

Arrangement of dorsal setae, 2.6.8.8.8.8.6.4.2.

NEOSCHÖNGASTIA COORONGENSIS (Hirst 1929)

Schöngastia coorongense Hirst, Ann. Mag. Nat. Hist. 1929, (10), 3, 564.

(Pl. viii, fig. 2)

This species was described from the ears of a rat at Robe, South Australia.

Fifteen syntypes from the Hirst material in the South Australian Museum give the following data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
65	86	28	26	20	30	48	44	65	—	32-56	
60	84	28	—	19	28	45	40	62	—	32-55	
65	84	32	—	—	—	43	43	—	—	32-45	
65	86	—	—	—	34	43	40	62	38 x 19	35-55	
71	95	32	25	19	32	43	38	57	30 x 18	35-55	
70	93	32	24	19	32	46	42	64	32 x 19	35-55	
75	92	35	32	20	33	40	36	55	35 x 19	38-50	
65	86	30	25	19	30	43	33	56	30 x 18	35-55	
68	91	30	29	22	30	46	43	58	—	35-50	
73	91	30	29	19	30	—	40	55	—	32-55	
65	85	28	24	21	30	47	40	59	30 x 17	32-55	
63	83	30	29	20	32	45	40	62	—	35-55	
70	105	38	32	23	34	48	41	65	—	35-57	
66	88	32	28	20	30	48	40	57	—	32-52	
70	93	32	28	20	29	42	41	58	—	35-50	
Mean	68	90	31	27	20	31	45	40	60	32 x 18	32-55

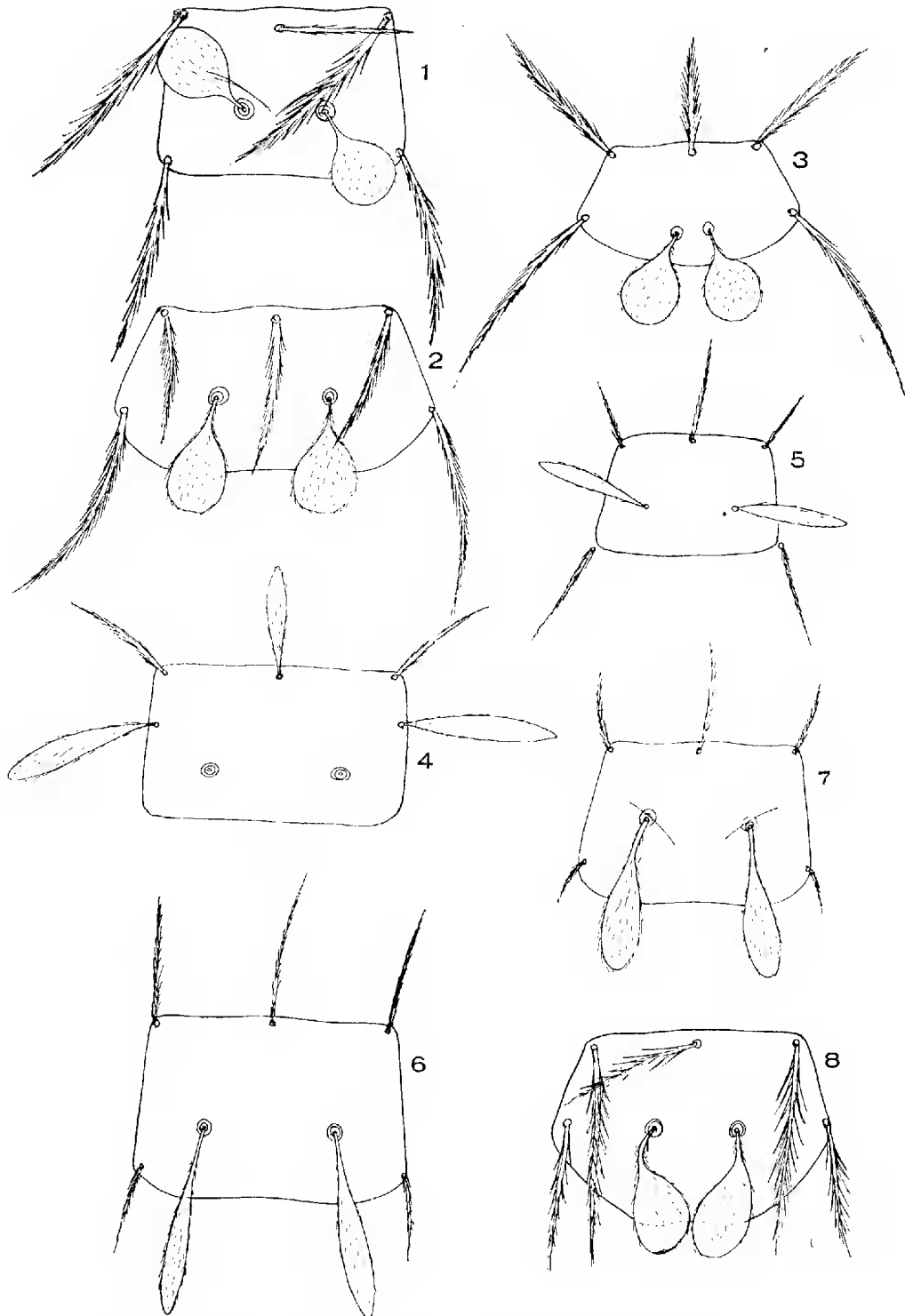
Arrangement of dorsal setae, 2.6.6.6.6.4.2.

NEOSCHÖNGASTIA GLOBULARE (Walch 1927)

Trombidium (Trombicula?) globulare Walch 1927, Genesk. Tijd. v. Ned. Indie, 67, (6), 929.

(Pl. viii, fig. 3)

We have not been able to see any authentic specimens of this species, and our drawing to scale of the dorsal scutum and the standard data are deduced from Walch's figure and description.



1, *Neoschöngastia antipodianum* (Hirst); 2, *coorongensis* (Hirst); 3, *N. globulare* (Walch); 4, *N. hastata* Gater; 5, *N. malayensis* Gater; 6, *N. lacunosa* Gater; 7, *N. impar* Gunther; 8, *N. schüffneri* Walch.

The data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
43	60	8	25	9	20	34	43	61	26	33

Arrangement of dorsal setae, 2.8.6.6.6.4.2.

It will be seen from the above and from the key to species that *N. globulare* is well characterised from the rest.

NEOSCHÖNGASTIA HASTATA (Gater 1932)

Trombicula hastata Gater 1932, Parasitology, 24.

(Pl. viii, fig. 4)

In the absence of sensillary setae Gater placed this species doubtfully as a *Trombicula*, but in view of the discovery by Gunther of the allied *Neoschöngastia foliata* in New Guinea, it seems more than likely that the sensillae of *hastata* will be clavate or globose as in *Neoschöngastia*.

For convenience of separation, therefore, we so place and key the species.

From Gater's description and figure, the standard data are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
69	71	37	29	15	15	30	32	42	—	45-50

Arrangement of dorsal setae, 2.8.6.6.4.2.

NEOSCHÖNGASTIA MALAYENSIS Gater 1932

Parasitology, 24, 1932.

(Pl. viii, fig. 5)

This species was described from the ears of *Rattus malaisia* Kloss, from Sungei Buloh, Selangor, Federated Malay States. It is rather remarkable that the PL are definitely outside of the scutum; in this respect, as Gater points out, being related to Hirst's *Schöngastia aethiopica* from the Gold Coast, Africa.

Gater gives the following details: scutal length 35, width 50, SB 22. From these and Gater's figure, we give the accompanying figure of the scutum to scale from which the standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
40	54	22	20	14	28	28	20	34	34	40

Dorsal setae, 0.8.8(6).4(6).4.2.

NEOSCHÖNGASTIA LACUNOSA Gater 1932.

Parasitology, 24, 1932

(Pl. viii, fig. 6)

Described from the ears of *Rattus sabanus vociferans* (Miller) from Sungei Buloh, Selangor, Federated Malay States.

We have been able to examine two specimens from the type host and locality, dated 23 July 1930. From these the standard data are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
66.5	74	36	31.5	23	43	46.5	35	25	53 x 6.5	42
66.5	78	38	31.5	—	43	45	35	26	53 x 6.5	42

Arrangement of dorsal setae, 2.6.8.8.6.6.4.2.

Gater gives the width of scutum as 78, length 55, and SB 37.

NEOSCHÖNGASTIA IMPAR Gunther 1939

Proc. Linn. Soc. N.S.W., 64, (1-2), 85.

= *N. bodensis* Gunther 1940, Proc. Linn. Soc. N.S.W., 65, (5-6), 482.

(Pl. viii, fig 7)

There appears to be no doubt that Gunther's *N. bodensis* 1940 described from the mouse deer, Bode River, British North Borneo, is the same as his *N. impar*

1939 from bandicoots and rats from New Guinea. That this is so will be seen from a comparison of the standard data derived by the examination of the type and three paratypes of *bodensis* and the type and five paratypes of *impar*.

N. impar—

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 55	—	—	20	23	33	—	21.5	13	—	—
„	- 50	63	28	21	23	33	—	21.5	13	—	28
Parat.	- 53	65	27	20	21	28	35	19	14	43 x 10	30
„	- 52	65	28	20	25	33	—	21	13	—	29
„	- 53	67	29	23	21	33	—	20	13	—	30
„	- 57	68	28	22	22	30	—	20	13	—	31
Mean	- 53	65	28	21	23	32	35	21	13	43 x 10	30

Arrangement of dorsal setae, 2.6.6.4(6).6(4).4.2.

Gunther gives scutal width 66, length 48, SB 27, AM 37.5, AL 19, PL 12.5.

N. bodensis—

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 48	60	28	20	20	33	35	21.5	14	45 x 10	20-40
„	- 50	60	30	20	21	33	33	23	13	40 x 10	—
„	- 51	58	28	20	20	35	35	23	15	—	20-40
Parat.	- 50	61	32	20	20	35	35	25	15	—	—
Mean	- 50	60	30	20	20	34	35	23	14	42 x 10	20-40

Gunther gives scutal width 70, length 47, SB 34, AM 37.5, AL 25, PL 20, Sens. 33 x 11, DS 2.6.6.6.4.4.2.

NEOSCHÖNGASTIA SCHÜFFNERI Walch 1923

Trombicula schüffneri Walch, Kitasato Arch., 5, (3), 1923; Tr. Vth. Bien. Congr. Far East. Assoc. Trop. Med., Singapore, 1923 (publ. 1924).

(Pl. viii, fig. 8)

This species was described from man at Deli in Sumatra.

We have not been able to see any authentic material and our figures of the dorsal scutum to scale and the following standard data are from Walch's description and figures:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
57	75	22	20	26	23	42	61	44	36 x 15	30

DS arranged 2.8.10.8.8.6 or 2.8.2.8.8.6.

Walch, in his second paper, claims to have reared the larvae through to the nymph, which as far as can be seen is a typical *Trombicula*, without eyes and with long, slender, shortly ciliated sensillae.

NEOSCHÖNGASTIA PSEUDOSCHÜFFNERI Walch 1927

Trombicula pseudoschüffneri Walch 1927, Genesk. Tijds. v. Ned. Indie, 67, (6), 922.

(Pl. ix, fig. 1)

Described from rats from the Lampong District of Macassar.

Again we can only reconstruct the dorsal scutum to scale from Walch's details and figures, and give the following standard data derived from the same sources:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
53	72	19	21	27	37	22	67	44	36	40

DS 2.8.6.6.4.2.

From its near allies this species can be separated by the key.

NEOSCHÖNGASTIA INDICA (Hirst 1915)

Schöngastia indica Hirst 1915, Bull. Ent. Res., 6, 183; Walch 1927, Geneskt. Tijds. v. Ned. Indie, 67, (6), 924.

Trombicula muris Walch 1922, Kitasato Arch. Exper. Med., 5, (3).

(Pl. ix, fig. 2)

Originally described by Hirst from Calcutta, India, on *Nesokia* (*Gunomys*) *bengalensis*, it has also been described by Walch from Deli, Sumatra, from rats, and from the Lampong district of Macassar, also from rats, and specimens are now recorded from rats at Cairns, Queensland (1940, W. G. Heaslip).

Besides the two specimens from Cairns we have been able to examine a specimen from Federated Malay States, and also a specimen, I.A.I.C.III, from Batavia, unnamed, but definitely of this species. The standard data for these specimens are:

Loc.	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Cairns	- 35	54	19	11+	16	27	23	16	21+	—	20-30
"	- 35	54	19	19	16	27	23	16	31	—	20-35
Batavia	- 39	55	23	18	20	27	23	17	29	26 x 10	32
F.M.S.	- 37	52	21	18	16	27	23	16	31	26 x 10	20-35
Mean	- 36.5	54	20.5	18.5	17	27	23	16	30	26 x 10	20-35

Walch, in his 1927 publication, recognised the synonymy of his *muris* with that of *indica* Hirst. It is evidently a wide ranging species, extending from India to Queensland.

NEOSCHÖNGASTIA DEBILIS Gater 1932

Parasitology, 24, 1932.

(Pl. ix, fig. 3)

Of this species which was described from *Rattus cremoriventer cremoriventer* (Miller) from Sungei Buloh, Selangor, Federated Malay States, we have not been able to examine any material.

Our scale drawing of the scutum is from Gater's data and figure, as are the following standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
40	48	17	13	11	21	30	20	36	—	—

NEOSCHÖNGASTIA LORIUS Gunther 1939

Neoschöngastia jimungi Gunther 1938, Med. J. Austr., 2, (6), 202 (*nom. nud.*);

lorius Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 86.

(Pl. ix, fig. 4)

This species was described from specimens from a parrot (*Lorius roratus*) from New Guinea. We have been privileged to examine the type slide, which besides the type contains three paratypes. Two of the latter and the type have been carefully measured for standard data as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 40	58	20	16	23	21.5	30	17	31.5	35 x 10	25
Parat	- 40	56.5	20	16	21.5	21.5	30	—	31.5	35 x 10	25
"	- 40	55	20	16	22	21.5	—	—	33	36 x 10	25

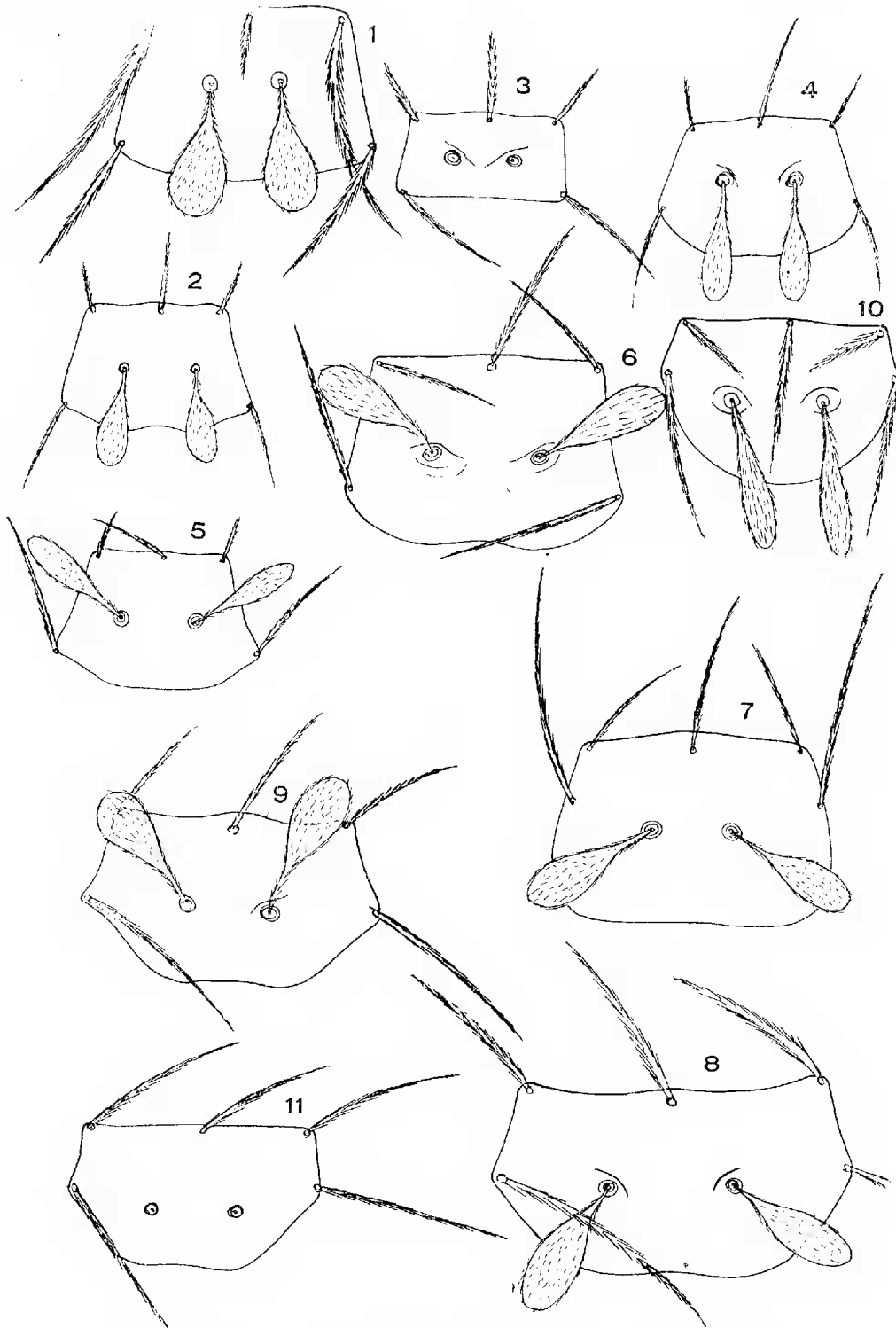
DS 2.6(2.4).4.2.4.2.16.12.

Gunther gives: scutal length 47, width 62.5, SB 20, AM 36, AL 25, PL 37.5, Sens. 30, DS 30.

***Neoschöngastia rattus* n. sp.**

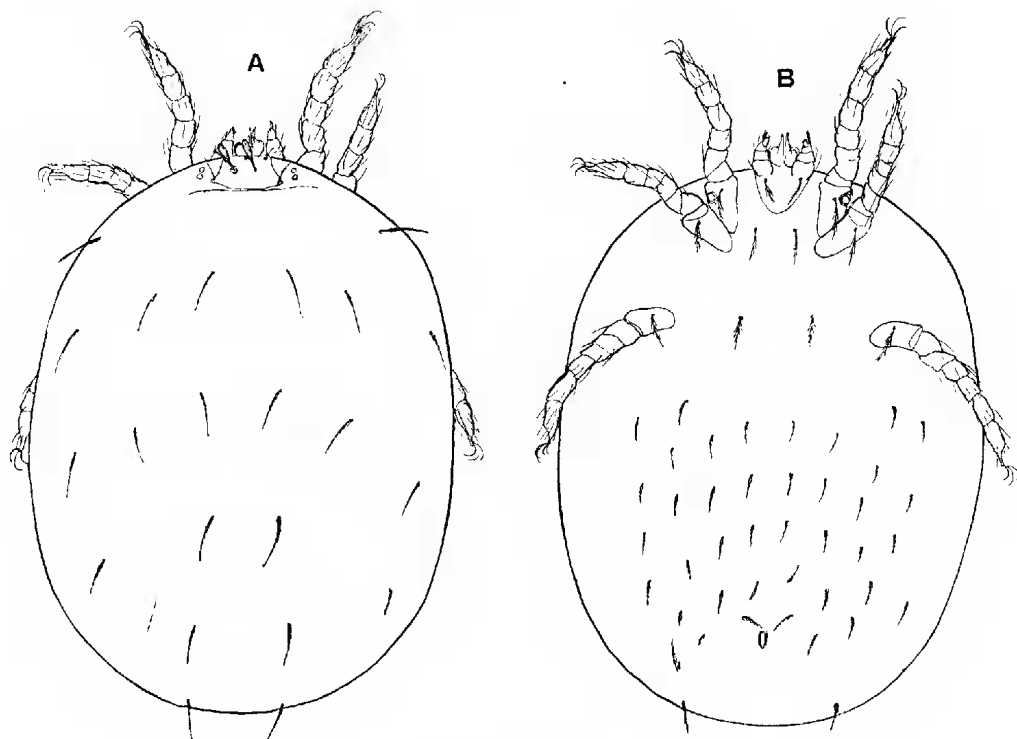
(Pl. ix, fig. 5; text fig. 11, A-B)

Description—Well-fed specimens 550 μ long, 390 μ wide, shape oval with sides flattish medially. Legs relatively small and short, I 160, II 145, III 160.



1, *Neoschöngastia pseudoschöffneri* (Walch); 2, *N. indica* (Hirst); 3, *N. debilis* Gater; 4, *N. lorius* Gunther; 5, *N. rattus* n. sp.; 6, *N. heaslipi* n. sp.; 7, *N. perameles* Wom.; 8, *N. westraliensis* Wom.; 9, *N. trichosuri* Wom.; 10, *N. dasycerci* (Hirst); 11, *N. shieldsi* Gunther.

Mandibles with non-serrate chelicerae. Palpi normal, tibial claw bifurcate. Dorsal scutum as in plate ix, fig. 5, with the following standard data, AW 36, PW 58, SB 20, ASB 19, SB 20, A-P 28, AM 24, AL 14, PL 38, Sens. 35 x 9, DS 20-40. Arrangement of DS 2.6.6.4.2.2.



Text fig. 11

Neoschongastia rattus n. sp.: A, dorsal; B, ventral.

The scutal and dorsal setae are shortly and finely ciliated. Sensillae clubbed with short stem and ciliated club. Eyes 2 + 2, small and away from scutum.

Ventrally each coxa with a single seta which has 4-5 long branches; gnathal part with a pair of similar setae, and a pair between coxae I and between coxae III, and thereafter 4.8.8.8.6.6.2. Legs with normal chaetotaxy and tarsi with paired claws, and a longer median pulvillus.

Loc. and Hosts—On rats, *Rattus assimilis*, at Imbil, 16 February 1939 (Smith), and Brisbane, Queensland, 5 July 1938 (W. G. H.).

Remarks—Of 10 specimens examined, the highest and lowest values for standard data are as follows:

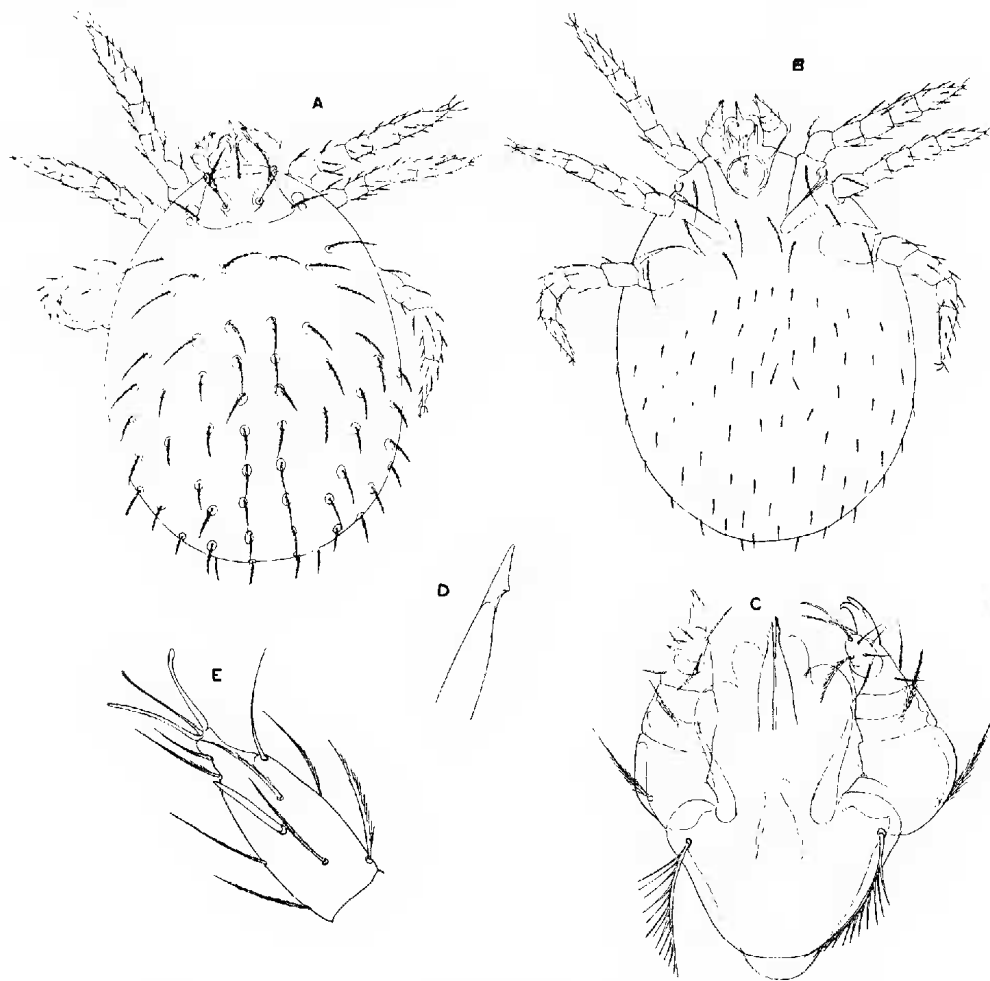
	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Highest	- 40	60	22	19	20	32	25	16	40	36 x 9	—
Lowest	- 32	56	19	19	18	24	22	11	34	32 x 8	—

Neoschongastia heaslipi n. sp.

(Pl. ix, fig. 6; text fig. 12)

Description—Length 375 μ , width 270 μ , shape somewhat rounded. Legs: I 240, II 225, III 240. Mandibles non-serrate with a single ventral tooth. Palpi as in text fig. 12, tibial claw trifurcate. Dorsal scutum as in pl. ix, fig. 6, with the following standard data: AW 62, PW 78, SB 29, ASB 27, PSB 24, A-P 36,

AM 46, AL 33, PL 49, Sens. 39×13 with strong ciliations. Dorsal setae 27-52 long, ciliated and arising from platelets, arranged 2.6.8.8.8.4.6.6.4.2, platelets 15 wide. Eyes 2 + 2, closely adjacent to scutum, anterior eye the larger. Venter; coxae each with a single long (45-50), pointed and ciliated seta; a similar pair between coxae I and between coxae III, thereafter shorter, 20-30, and arranged 12.12.12.10.8.6.4, approximately.



Text fig. 12

Neoschongastia heaslipi n. sp.: A, dorsal; B, ventral; C, mouth parts and palp from below; D, chelicera; E, tarsus I.

Loc. and Hosts—From rats at Intake, Cairns, Queensland, 1940 (W. G. H.).

Remarks—Remarkable for the small dorsal platelets. The standard data for the three specimens examined are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
59	75	29	28	24	38	46	32	49	40×13	27-52
62	80	29	28	23	36	46	33	49	39×13	30-52
65	79	29	24	24	34	46	34	49	39×13	30-52
Mean -	62	78	29	27	36	46	33	49	39×13	29-52

Neoschongastia perameles Wom. 1939Trans. Roy. Soc. S. Aust., **63**, (2), 160, 1939.

(Pl. ix, fig. 7)

In addition to the original records of this species, it was collected from a bandicoot (*Isoodon torosus*) at Cairns, Queensland, in 1939, by Dr. W. G. Heaslip.

Altogether 30 specimens have been measured for standard data of which the mean, maximum and minimum are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Highest	- 65	81	29	32	29	21	50	42	73	43 x 13	—
Lowest	- 54	70	19	23	24	16	43	29	62	38 x 13	—
Mean	- 60	73	24	27	27	19	47	36	68	39 x 13	30-50

NEOSCHÖNGASTIA WESTRALIENSIS (Wom. 1934)*Schöngastia westraliense*, Rec. S. Aust. Mus., **5**, (2).

(Pl. ix, fig. 8)

This species was described from the ears of a cat at Greenbushes, West Australia. The standard data for six specimens on the type slide are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
84	102	37	24	24	27	54	46	75	—	—	45-70
86	102	38	26	26	27	50	46	75	—	—	45-75
86	102	35	28	24	27	51	46	75	—	—	45-72
81	104	38	26	24	27	—	49	78	40 x 13	—	45-75
84	98	35	26	24	27	—	43	75	—	—	43-75
84	100	35	30	26	27	—	46	73	40 x 13	—	45-75

Arrangements of DS, 2.8.6.6.6(4).4(6).2.

NEOSCHÖNGASTIA TRICHOSURI Wom. 1939*Neoschöngastia westraliense* v. *trichosuri* Wom. 1939, Trans. Roy. Soc. S. Aust., **63**, (2), 160.

(Pl. ix, fig. 9)

This form, which was originally regarded as only a variety of the Western Australian *westraliensis* Wom., must be raised to specific rank. The standard data for the only specimen from *Trichosurus vulpecula*, Nambour, Queensland, are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
63	84	23	29	29	27	43	35	56	40 x 13	—	30-54

Arrangement of DS, 2.8.6.6.6.4.2.

NEOSCHÖNGASTIA DASYCERCI (Hirst 1929)*Schöngastia dasycerci* Hirst Proc. Zool. Soc., London, 1929, (2).

(Pl. ix, fig. 10)

Described from the ears of *Dasyercus cristicauda* from Ooldea, South Australia. The standard data for seven specimens of the original material are as follows:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
54	65	26	24	23	14	38	21	46	—	—	30-40
54	65	26	24	23	15	40	23	46	43 x 8	—	30-40
54	65	24	24	20	15	38	23	43	—	—	30-40
54	62	24	23	21	15	40	23	48	43 x 8	—	30-40
59	67	27	25	22	15	38	21	48	—	—	30-45
54	—	—	—	—	—	41	23	—	43 x 8	—	30-48
57	67	27	29	22	14	—	22	46	—	—	30-45
Mean	- 55	65	26	24	22	15	39	22	46	43 x 8	30-48

Arrangement of DS, 2.8.6.6.6.2.2.

NEOSCHONGASTIA SHIELDSI Gunther 1941

Proc. Linn. Soc. N.S.W., 66, (3-4), 157, 1941.

(Pl. ix, fig. 11)

Described from *Melomys ruber* Thomas, from Bulolo, T. N. G.

The figure of the dorsal scutum is drawn to scale from the following standard data deduced from Gunther's details and figures:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
61.5	70	24	24	16	16	37.5	45	56	—	—

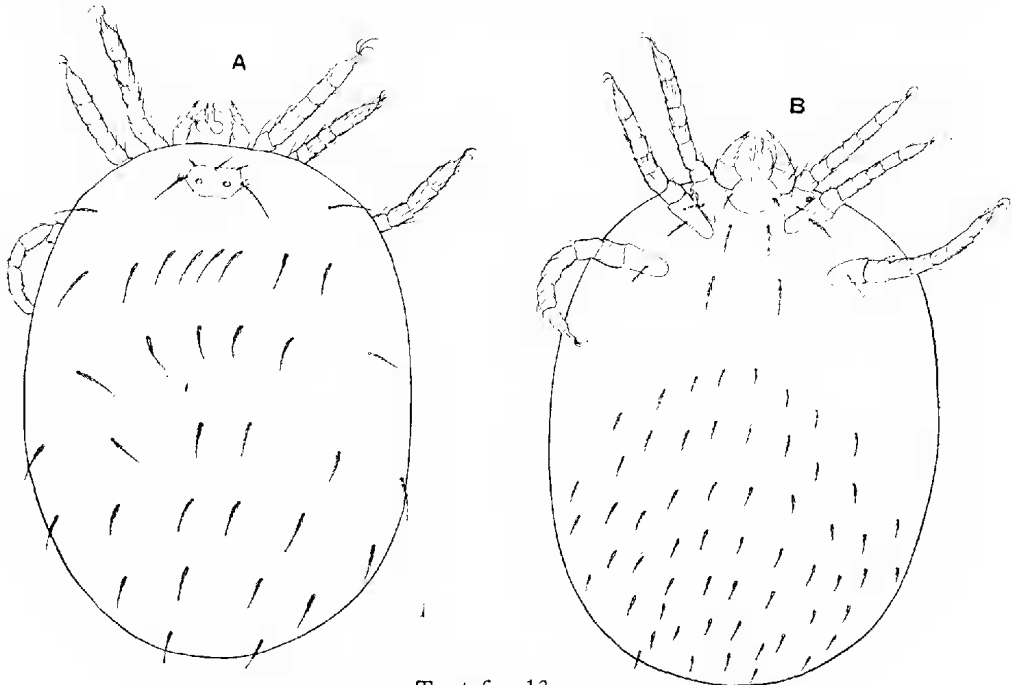
Neoschongastia hirsti n. sp.

(Pl. x, fig. 1; text fig. 13, A-B)

Description—Length to 690 μ , width 500 μ , oval, with sides medially rather straight. Legs: I 255, II 225, III 290. Mandibles with non-serrate chelicerae. Palpi normal, with bifurcate tibial claw. Dorsal scutum as in pl. x, fig. 1, with the following standard data: AW 67, PW 81, SB 32, ASB 26, PSB 22, A-P 16, AM 47, AL 27.5, PL 72. Sens. lacking in all specimens. DS 30-70 long, and arranged 2.8.6.6.4.2. Eyes 2 + 2. Ventrally all coxae with a single long ciliated seta; a pair of similar setae between coxae I and between coxae III, thereafter about eight rows of 8-10 short ciliated setae, arranged as in text fig. 13, B.

The standard data for the six specimens are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Cairns	- 63	81	32	29	20	17	48	27	70	—	30-67
"	- 62	84	32	24	24	19	46	27	70	—	30-65
Imbil.	- 67	81	32	27	20	15	46	27	70	—	30-67
"	- 73	81	32	26	22	15	48	27	72	—	35-70
"	- 67	81	32	26	23	15	46	30	73	—	32-70
"	- 70	78	32	24	23	15	48	27	75	—	30-70
Mean	- 67	81	32	26	22	16	47	27.5	72	—	30-70



Text fig. 13

Neoschongastia hirsti n. sp.: A, dorsal; B, ventral.

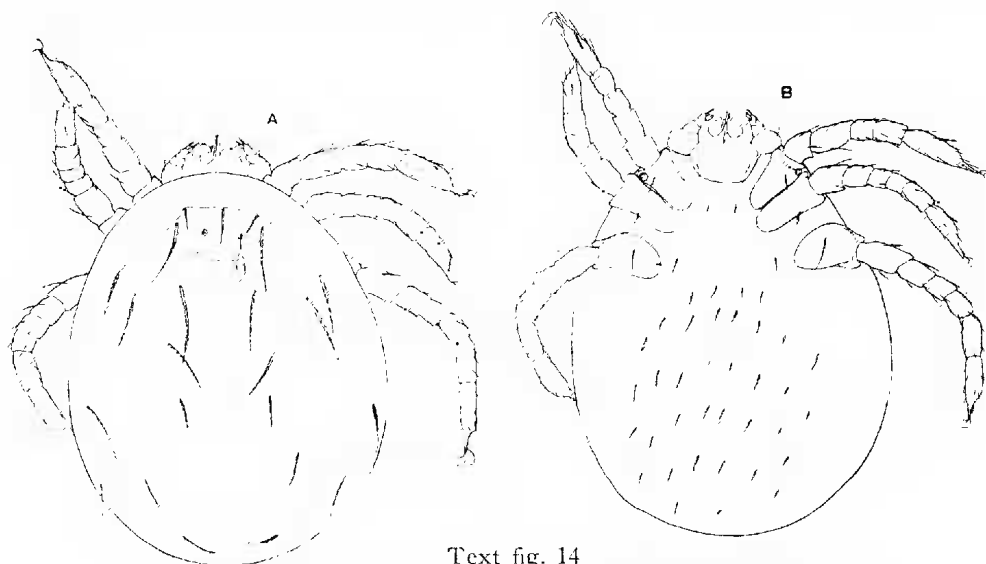
Loc. and Hosts—Two specimens from rats, Cairns, Queensland, 1938 (W. G. H.), and four specimens from *Melomys cervenipes*, Imbil, Queensland, August 1938 (Smith).

Remarks—The relationship of this species to the others can be seen from the key.

***Neoschongastia similis* n. sp.**

(Pl. x, fig. 2; text fig. 14, A-B)

Description—Rounded species, length to 430 μ , width to 340 μ . Legs: I 260, II 227, III 290. Mandibles with non-serrate chelicerae. Palpi normal, with bifurcate tibial claw. Dorsal scutum as in pl. x, fig. 2, with the following mean standard data: AW 64.5, PW 84.5, SB 33, ASB 23, PSB 32, A-P 12, AM 53, AL 23, PL 95. Sens. 50 x 11, DS 40-90, arranged 2.4.4.4.2., occasionally 2.4.2.4.4.2. Eyes 2 + 2. Venter; all coxae with a single ciliated seta; a pair of similar setae between coxae I and between coxae III, thereafter about 36 short setae roughly in rows of eight. Tarsi normal with paired claws and single claw-like empodium.



Text fig. 14

***Neoschongastia similis* n. sp.**: A, dorsal; B, ventral.

Loc. and Host—On rats from Cairns, Queensland, 1939 (W. G. H.).

Remarks—Can be distinguished as in the key to species. Eight specimens have been measured as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
62	81	32	24	32	12	—	16+	81+	—	45-90
67	89	35	22	35	12	—	13+	86+	—	45-80
65	86	32	24	36	13	—	16+	97	—	40-95
65	86	32	25	29	13	—	—	94	—	40-97
65	84	32	22	29	11	—	19+	90	—	45-95
65	86	35	24	31	11	53	23+	89	—	45-95
60	81	32	23	32	13	—	11+	97	—	45-95
65	84	32	23	32	12	—	19+	94	—	40-90

NEOSCHÖNGASTIA DERRICKI Wom. 1939

Trans. Roy. Soc. S. Aust., 63, (2), 162.

(Pl. x, fig. 3)

The type specimen of this species was from *Rattus lutreolus* and two paratypes from *R. assimilis*, all from Imbil, Queensland, August 1938 (Smith). We have also six other specimens from rats at Cairns, Queensland, 1939 (W. G. H.).



1, *Neoschongastia hirsti* n. sp.; 2, *N. similis* n. sp.; 3, *N. derricki* Wom.; 4, *N. guntheri* n. sp.; 5, *N. smithi* Wom.; 6, *N. phascogale* n. sp.; 7, *N. cairnsensis* n. sp. 8, *N. cairnsensis* v. *gateri* nov.

The standard data for all these are as follows:

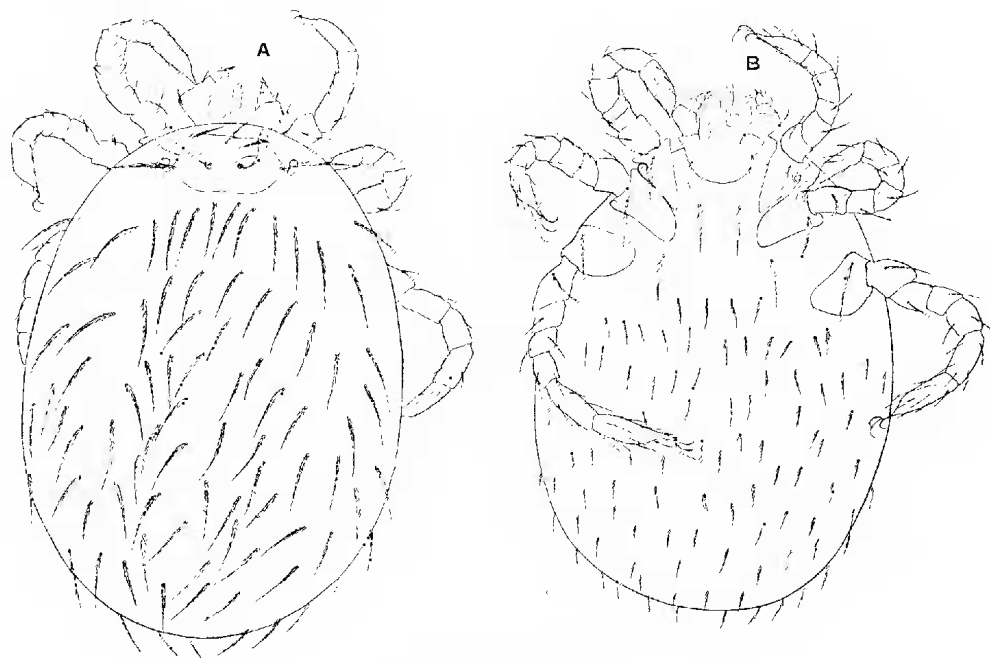
	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type, Imbil.	- 67	90	35	25	23	12	45+	18+	81+	—	50-90
Parat. „	- 67	84	32	24	26	12	45+	—	86	—	50-86
„ „	- 67	86	35	26	24	12	51	16+	83+	38 x 8	50-90
Cairns	- - 65	84	33	26	27	11	50	27	86	—	50-90
„	- - 67	84	35	24	24	11	54	24+	89	—	50-90
„	- - 62	84	35	24	26	11.5	—	24+	90	—	50-90
„	- - 62	84	35	26	24	11	58	24+	92	38 x 11	50-92
„	- - 65	84	33	25	24	11	54	21+	86	38 x 11	50-90
„	- - 67	86	35	25	24	11	60	24+	90	—	50-90
Mean	- - 65.5	85	34	25	25	11.5	57	27	89	38 x 11	50-90

Arrangement of DS, 2.6.6.6.4.2.

Neoschongastia guntheri n. sp.

(Pl. x, fig. 4; text fig. 15, A-B)

Description—Length 450 μ , width 310 μ , shape oval. Legs: I 330, II 300, III 350. Mandibles with non-serrate chelicerae. Palpi normal, tibial claw trifurcate. Dorsal scutum an in pl. x, fig. 4, with the following standard data: AW 78, PW 97, SB 31, ASB 31, PSB 27, A-P 32, AM 57, AL 40, PL 67. Sens. clubbed, 52 long by 11 wide. Dorsal setae 35-75 long, arranged 2.12.12.12.12.10.8.4.2. Eyes 2 + 2. Venter; all coxae with a single long ciliated seta, a pair between coxae I and another between coxae III, behind coxae III with numerous short ciliated setae as in text fig. 15, B.



Text fig. 15

Neoschongastia guntheri n. sp.: A, dorsal; B, ventral.

Loc. and Hosts—Numerous specimens from rats at Cairns, Queensland, 1939 (W. G. H.).

Remarks—Relationship to other species as in key. Seventeen specimens have been measured as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
78	95	30	28	26	32	60	40	65	54 x 11	40-75
76	95	30	28	26	35	60	40	67	54 x 11	40-75
81	97	30	28	26	32	57	41	67	52 x 11	40-75
76	94	32	28	26	32	60	41	65	52 x 11	40-75
78	97	32	30	27	32	56	38	67	52 x 11	40-72
78	97	30	27	27	32	60	40	68	52 x 11	40-75
78	97	32	30	30	32	—	38	67	—	40-75
75	94	32	27	27	32	60	40	68	52 x 11	40-70
78	97	32	32	27	32	54	41	65	52 x 11	35-70
78	97	31	30	27	32	57	40	70	52 x 11	40-70
75	97	30	31	27	32	56	40	67	52 x 11	40-70
78	97	32	30	27	27	56	40	67	52 x 11	40-70
81	102	32	32	25	32	—	41	70	49 x 11	40-73
81	100	32	32	30	35	56	41	70	51 x 11	40-71
78	103	32	35	27	36	60	38	67	51 x 11	40-70
75	97	32	32	24	30	49	38	67	51 x 11	40-70
75	97	32	32	32	32	54	37	65	51 x 11	40-70
Mean - 78	97	31	31	27	32	57	40	67	52 x 11	35-75

NEOSCHÖNGASTIA SMITHI Wom. 1939

Trans. Roy Soc. S. Aust., **63**, (2), 164.

(Pl. x, fig. 5)

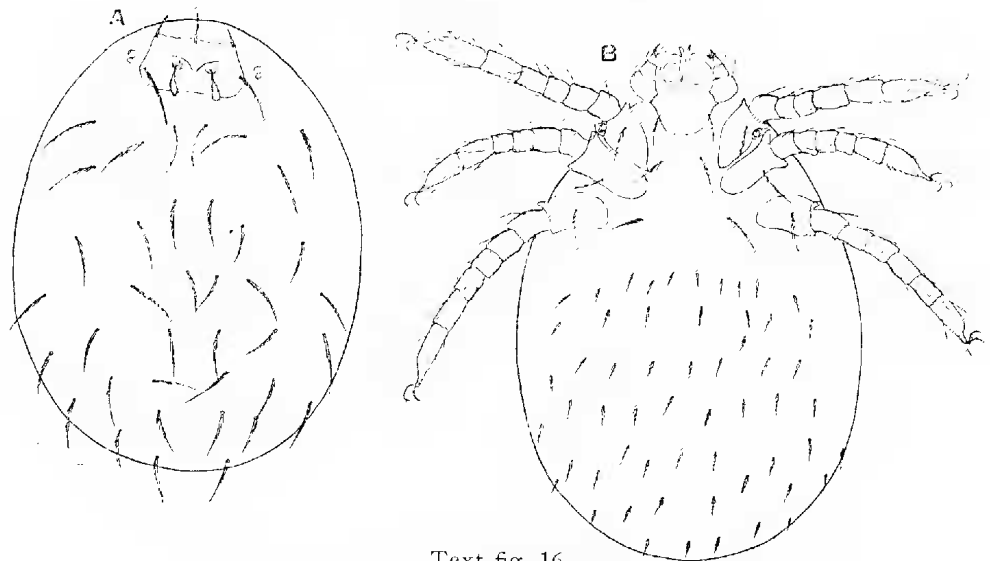
This species was described from specimens from *Rattus assimilis* from Imbil, Queensland. The type and two paratypes are on the same slide and give the following standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
70	81	27	30	24	32	55	38	64	43	32-67
70	81	27	30	24	27	53	32	63	—	35-70
70	81	27	30	24	30	51	34	62	—	35-74

The arrangement of DS is 2.8.8.8.6.4.2.

Neoschongastia phascogale n. sp.

(Pl. x, fig. 6; text fig. 16, A-B)



Text fig. 16

Neoschongastia phascogale n. sp.: A, dorsal; B, ventral.

Description—Shape an elongate oval, length (fed) to 500 μ , width 350 μ . Legs: I 260, II 220, III 290. Mandibles with non-serrate chelicerae. Palpi normal, tibial claw bifurcate. Dorsal scutum as in pl. x, fig. 6, with the following standard data: AW 72, PW 83, SB 30, ASB 30, PSB 24, A-P 31, AM 54, AL 38, PL 64, Sens. 43 x 13, DS 32-70. Arrangement of DS, 2.6.6.6.6.4.2. Eyes 2 + 2. Venter: all coxae with a single ciliated seta; a pair of similar setae between coxae I and between coxae III, thereafter numerous shorter setae as in text fig. 16, B.

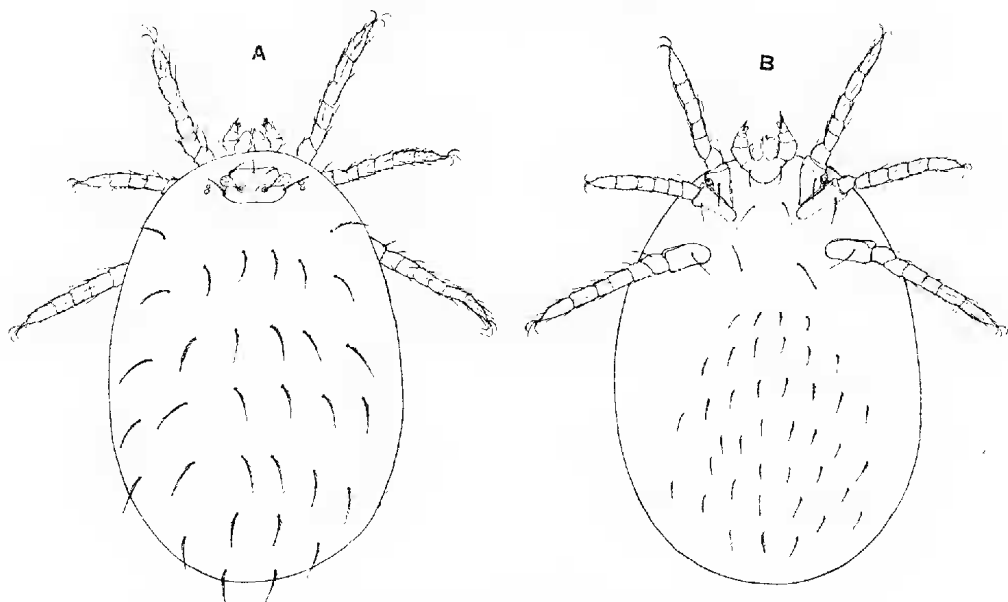
Loc. and Hosts—Type material from *Phascogale* sp. from Brisbane, 19 January 1938 (D. J. W. Smith); from *Isoodon torosus*, W. Cairns 1940 (W. G. H.); *Perameles nasuta* Palm Woods, December 1938 (D. J. W. Smith).

Remarks—Standard data for 19 specimens:

Host	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
<i>Phascogale</i> sp.	70	81	32	27	22	35	54	37	64	43	35-70
"	- 73	83	30	32	24	32	54	40	65	43	35-70
"	- 70	81	30	30	24	32	54	37	62	—	35-70
"	- 70	83	32	29	24	30	54	38	67	43	35-70
<i>Isoodon</i>	- 71	84	30	29	24	29	52	38	58	41 x 13	65
"	- 71	84	30	30	24	30	51	36	56	36 x 10	65
"	- 71	84	30	29	23	29	50	—	62	39 x 13	62
"	- 71	84	29	30	23	27	—	—	62	39 x 12	63
"	- 72	83	28	30	23	31	55	38	63	43 x 13	65
"	- 71	82	30	—	24	29	55	39	65	45 x 13	69
"	- 68	79	28	—	24	30	53	38	59	—	67
"	- 73	84	29	31	25	32	55	39	65	—	69
"	- 75	86	30	30	23	32	55	39	62	45 x 13	65
<i>Perameles</i>	- 73	83	30	30	24	31	54	38	64	43	35-75
"	- 73	86	31	30	24	32	54	40	67	43	35-70
"	- 73	86	30	30	24	30	54	40	67	43	32-65
"	- 70	83	30	30	22	30	—	38	62	43	32-67
"	- 73	83	30	32	24	32	54	38	62	45	35-70
"	- 73	86	30	30	24	30	54	40	67	48	35-67
Mean	- 72	83	30	30	24	31	54	38	64	43 x 13	32-75

Neoschongastia cairnsensis n. sp.

(Pl. x, fig. 7; text fig. 17, A-B)



Text fig. 17

Neoschongastia cairnsensis n. sp.: A, dorsal; B, ventral.

Description—Oval in shape. Length to 690 μ , width to 430 μ . Legs: I 260, II 210, III 260. Mandibles with non-serrate chelicerae. Palpi normal, tibial claw trifurcate. Dorsal scutum as in pl. x, fig. 7, with the following standard data (mean of 55 specimens): AW 54, PW 75, SB 27, ASB 23, PSB 20, A-P 32, AM 38, AL 29, PL 50, Sens. 35 x 14, DS 35-50 long and arranged 2.6.6.6.4.2. Eyes 2 + 2. Venter as in text fig. 17, B; a single seta on each coxa, a pair between coxae I and between coxae III, then many irregular rows of shorter setae.

Loc. and Hosts—Rats, Cairns, (W. G. H.); *R. lutreolus* and *R. assimilis*, Imbil, 1938 (Smith); *R. youngi*, Cowan Cowan, 1938 (Smith); *Isoodon torosus*, Cowan Cowan and Brisbane, 1939 (W. G. H.).

Remarks—Apparently a very common species in Queensland.

Fifty-five specimens have been measured for standard data, of which the extremes are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Max.	- 56	85	32	27	22	35	42	36	54	40	—
Min.	- 51	68	23	19	16	26.5	30	24	43	30	—

v. *gateri* nov.

(Pl. x, fig. 8)

Description—Only differs from the above in the proportionately larger scutum. The standard data for the six specimens are:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
65	100	32	30	26	38	48	35	60	38 x 14	32-58	
75	100	35	30	24	38	45	32	60	40 x 14	32-60	
65	94	33	28	21	35	32	32	57	—	30-50	
73	94	32	30	21	35	46	32	60	40 x 14	35-50	
67	90	32	27	21	35	43	32	54	—	30-50	
73	105	38	30	24	39	46	30	57	—	30-50	
Mean -	70	97	34	34	23	37	46	32	58	40 x 14	30-60

Loc. and Hosts—From rats, Cairns, 1938 and 1939 (W. G. H.).

Genus PARASCHÖNGASTIA Wom. 1939

Trans. Roy. Soc. S. Aust., 63, (2), 165.

Scutum with a well-defined crest, often in long curves, with the pseudo-stigmata in the vertical posterior walls of the crest. Anterior part of scutum pitted only, posterior with more or less circular striations surrounding pits. Body striated anteriorly, pitted posteriorly. Coxae with one, two or three setae. Genotype *Neoschöngastia ycomansi* Gunther 1939.

In this genus we now place *Trombicula gallinarum* Kaw. and Yam. from Formosa, such decision being placed on the details and figures given by Kawamura and Yamaguchi 1921. Only five species are known.

KEY TO THE SPECIES OF PARASCHÖNGASTIA

- 1 Coxae III with three setae. No pitted caudal area or plate. Scutal crest indefinite medially. DS 2.14.10.12.6.14.14.12.8.4. *P. dubia* (Gunther 1939)
- 2 Coxae III with one or two setae. 2
- 2 Coxae III with one seta. 3
- 3 Coxae III with two setae. 4
- 3 AM much shorter than AL or PL. AW 58, DS 2.14.14.10.8.8.6.6.2.2. Caudal area with pitting and weak striations. *P. backhousei* (Gunther 1939)
- AM about equal to AL. AW 53, DS 2.12.10.8.4.2. Caudal area? *P. gallinarum* (Kaw. and Yam., 1921)

- 4 Pitting over posterior fourth of dorsum. DS 100 in number, arranged 2.16.8(10).12(10).10(8).10(8).12.6.6.6.4, last five rows arising from tubercles.

P. yeomansi (Gunther 1939)

Posterior pitted area relatively small and bounded anteriorly by a circle of tubercles with long straight setae. DS 2.8(10).12(10).6.8(1).8.8(6), then circle of tubercles, then 12 arising from irregular oval tubercles or platelets.

P. retrocincla (Gunther 1939)

PARASCHÖNGASTIA DUBIA (Gunther 1939)

Neoschöngastia incerta Gunther 1938, *nom. nud.*, Med. J. Aust., 2, (6), 202.

Neoschöngastia dubia Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 89.

Paraschöngastia dubia Womersley 1939, Trans. Roy. Soc. S. Aust., 63, (2), 165;

(Pl. xi, fig. 2)

We have been able to examine the type specimen (unique) from the New Guinea bush fowl (*Megapodius duperréyi*) which, as stated by Gunther, is imperfect in lacking sensillae and chelicerae. The standard data are as follows:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
75	98	60	25	25	38	45	80	71	—	—

Arrangement of dorsal setae, 2.14.10.12.6.14.14.12.8.4.

The dimensions given by Gunther are: scutal length 62.5, width 100, AM 47, AL 84.5, PL 75, SB 56. Coxae III with three setae.

PARASCHÖNGASTIA BACKHOUSEI (Gunther 1939)

Neoschöngastia fournieri Gunther 1938, *nom. nud.*, Med. J. Aust., 2, (6), 207.

Neoschöngastia backhousei Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 89.

Paraschöngastia backhousei Womersley 1939, Trans. Roy. Soc. S. Aust., 63, (2), 165; Gunther 1940, Proc. Linn. Soc. N.S.W., 65, (3-4), 252.

(Pl. xi, fig. 3)

We have examined the type material of this species and give the following standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.
58	72	48	23.5	25	42	37.5	47	42	30 x 15

DS 30-40 long and arranged as given by Gunther, 2.14.14.10.8.8.6.6.2.2.

Gunther gives the scutal length as 47 and the width 75. Coxae III with only one seta. By an error in the key to Womersley's 1939 paper the name of this species was given as *megapodius*.

PARASCHÖNGASTIA GALLINARUM (Kaw. and Yam.) 1921

Trombicula gallinarum Kawamura and Yamaguchi 1921, Kitas. Arch. Exp. Med., 4, 169.

(Pl. xi, fig. 4)

Kawamura and Yamaguchi attribute this name to Hatori for a "red mite" of fowls from Formosa, but as far as we have been able to ascertain Hatori did not use a specific name, and even if he did, it would be a *nomen nudum*, for he gave no description. Kawamura and Yamaguchi, however, give a very full description, so that the species is really *gallinarum* Kaw. and Yam. These authors (*loc. cit.*) claim to have reared this species through to the nymph, and state that it also has clavate sensillae but not so broadly so as in the larva.

Kawamura and Yamaguchi give the following details: length of scutum 42, width 65.1, Sens. 22.5 long, head 14.5 x 14.5 strongly ciliated. DS 33 long and arranged 2.12.10.8.4.2. Coxae all with one seta.

From the above and Kawamura and Yamaguchi's figure we compute the standard data:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.
52	60	35	16.5	26.5	31	32	35	50	22.5 x 14.5

Fletcher et al. (1938) refer to a "red mite" of fowls from the Federated Malay States as this species, but give no description, only figures of the dorsum and dorsal scutum. The arrangement of DS appears to be only slightly different, 2.12.8.6.10.4.2, from that shown by Kawamura and Yamaguchi. The dorsal scutum also only differs slightly in general form, but no dimensions are given. On the assumption that the AW is the same in both the Formosan and Federated Malay States specimens, the standard data for the latter from Fletcher's figure will be:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.
52	60	42	19	26	30	34	35	33	26

The obvious differences in these figures are that the sensillae bases (SB) are much wider apart, that the normal scutal setae are very slender and shortly ciliated and that the sensillae are only sparsely and shortly setulate. However, without fresh material the precise status of the Federated Malay States species is somewhat doubtful.

PARASCHÖNGASTIA YEOMANSI (Gunther 1939)

Neoschöngastia jamesi Gunther 1938 (*nom. nud.*), Med. J. Aust., 2, (6), 202.

Neoschöngastia yeomansi Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1 and 2), 81.

Paraschöngastia yeomansi Wom. 1939, Trans. Roy. Soc. S. Aust., 63, (2), 165; Gunther 1940, Proc. Linn. Soc. N.S.W., 65, (3-4), 252.

(Pl. xi, fig. 5)

This species was described from 50 specimens from *Megapodius duperreyi* from New Guinea. We have been able to examine the type slide containing three specimens, and also nine paratypes. From these the standard data are:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS	
78	103	61.5	23	25	35	—	75	50	38 x 20	40-6	
71.5	91.5	58	23	25	33	35	75	53	35 x 20	40-60	
76	96	62	21	25	33	33	74	58	35 x 20	35-65	
73	95	62	27	23	32	40	79	56	39 x 19	35-65	
76	91	64	25	—	33	41	83	—	39 x 19	—	
75	94	60	26	28	34	35	75	53	39 x 19	35-60	
72	94	65	29	25	33	40	80	55	40 x 19	40-67	
72	101	65	27	28	33	40	84	55	39 x 19	—	
73	94	62	28	23	32	39	75	52	39 x 19	35-6	
73	97	64	26	25	32	36	75	55	39 x 19	40-60	
75	104	68	29	24	32	39	78	55	—	—	
72	96	61	25	25	38	38	75	55	—	—	
Mean -	74	98	63	26	25.5	33	38	77	54	39 x 19	35-6

Arrangement of DS, 2.16.8(10).12(10).10(8).10.8(10).12.6.6.6.4.

Gunther gives the following: scutal length 56, width 100, AM 37.5, AL 80, PL 60, SB 62.5.

PARASCHÖNGASTIA RETROCINCTA (Gunther 1939)

Neoschöngastia retrocoronata Gunther 1938, *nom. nud.*, Med. J. Aust., 2, (6), 202.

Neoschöngastia retrocincta Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 87.

Paraschöngastia retrocincta Wom. 1939, Trans. Roy. Soc. S. Aust., 63, (2), 165; Gunther 1940, Proc. Linn. Soc. N.S.W., 65, (3-4), 247.

(Pl. xi, fig. 6)

We have examined the type and three paratypes of this species with the following results:

	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Type	- 70	91	55	20	23	35	36	70	50	35 x 20	35
Parat.	- 70	88	55	20	25	35	—	—	—	—	—
"	- 70	80	56	22	—	35	36	70	44	38 x 20	40
"	- 70	80	56	22	24	35	36	70	50	— x 20	45
Mean	- 70	85	55.5	21	24	35	36	70	48	36 x 20	40

The DS are arranged, 2.8(10).12(10).6.8(10).8(6), 17 tubercles plus 11 (13).

Gunther's details are: scutal length 52, width 87, AM 37.5, AL 56, PL 47, SB 53.

Genus **Guntherana** nom. nov.

for *Guntheria* Wom. 1939, Trans. Roy. Soc. S. Aust., **63**, (2), 157.

We are indebted to Mr. G. Whitley, of the Australian Museum, for pointing out to us that *Guntheria* Wom. is preoccupied by *Guntheria* Bleeker 1862 for a fish. We therefore propose the name of *Guntherana* in its stead.

GUNTHERANA BIPYGALIS (Gunther 1939)

Neoschöngastia callipygea Gunther 1938, nom. nud., Med. J. Aust., **2**, (6), 202.

Neoschöngastia kallipygos Gunther 1939, Proc. Linn. Soc. N.S.W., **64**, (1-2), 83.

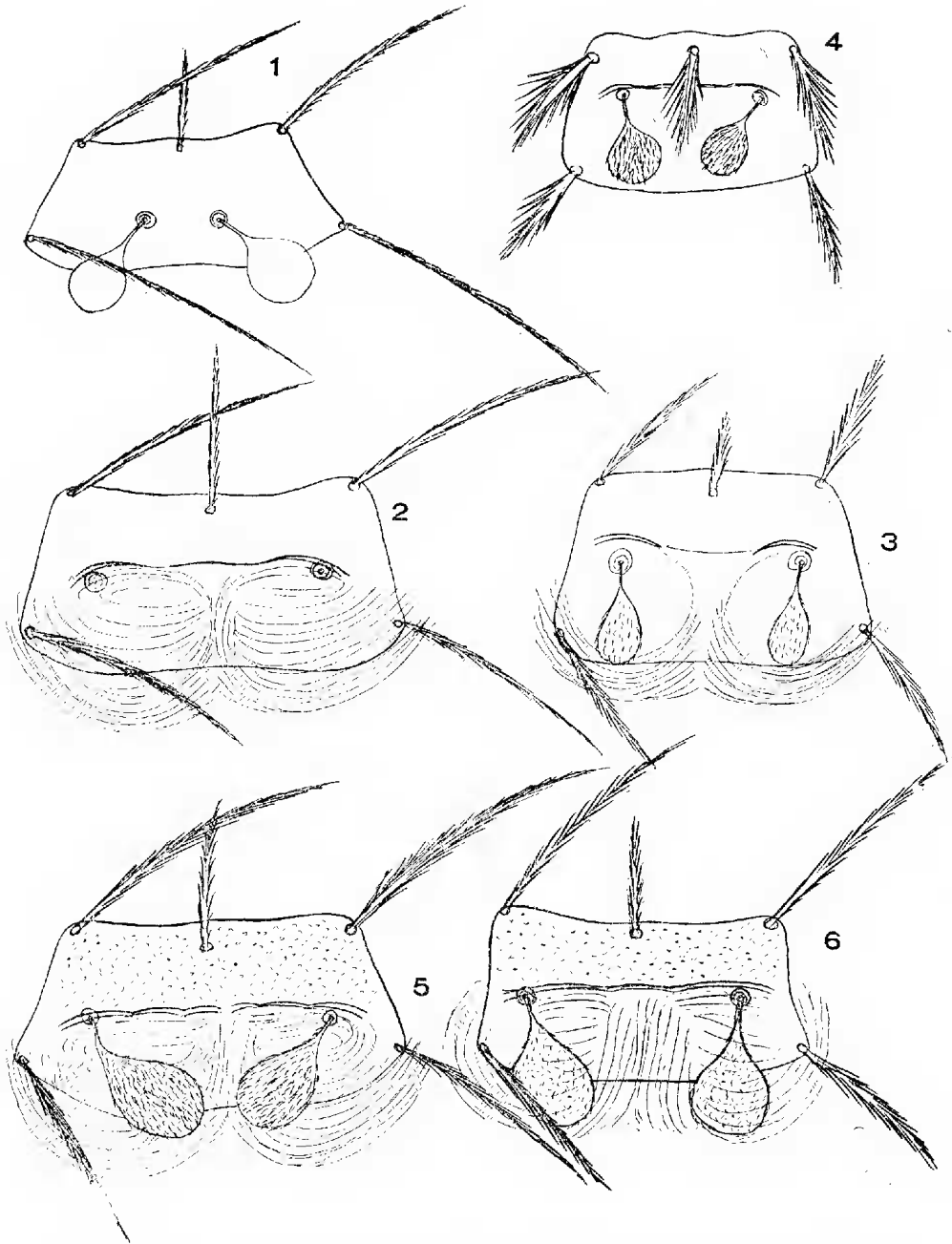
Neoschöngastia bipygalis Gunther, *ibid.*, 1939, **64**, (5-6), 471.

Guntheria kallipygos Wom. 1939, Trans. Roy. Soc. S. Aust., **63**, (2), 157.

(Pl. xi, fig. 1)

This interesting species was originally described by Gunther from New Guinea and recorded by Womersley from both rats and bandicoots from South Queensland, and subsequently (1939-1940, W. G. H.) specimens were collected from North Queensland from rats and *Isodon torosus*. Standard data for 19 specimens, including two of type material, are as follows:

Loc. and Host	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Bulolo, N.G., Type	- 58	68	21	21	13	26	—	65.5	80	30 x 15	—
" " Parat.	- 58	92	23.5	—	—	—	—	—	—	—	—
<i>M. cerrenipes</i> , Imbil., 8/1938 (Smith)	- 63	84	21	23.5	13	29	31.5	—	91.5	34 x 16	—
<i>R. youngi</i> , Cowan Cowan, 9/36 (Smith)	63	74	18.5	23.5	13	29	31.5	73.6	91.5	30 x 15	—
" "	58	74	18.5	23.5	11	26.5	30	75	80	—	—
" "	60	74	18	23.5	13	26.5	30	73.5	—	—	—
" "	52.5	71	17	23.5	12	26.5	30	73.5	96	—	—
" "	58	74	18.5	23.5	13	26.5	—	—	96	—	—
" "	58	74	18.5	23.5	13	29	34	73.5	96	—	—
<i>I. torosus</i> , Cowan Cowan, 9/38 (Smith)	58	71	18.5	23.5	13	29	30	78	99	—	—
" "	58	68.5	18.5	23.5	13	27	—	73.5	94	—	—
" "	58	74	18.5	23.5	13	27	34	78	105	—	—
" "	65	87	23.5	26	13	29	31	71	100	—	—
Rat, Brisbane, 1939 (Smith)	- 58	78	21	23.5	11	27	34	78	100	—	—
<i>I. torosus</i> , Cairns, 1939, W. G. H.	- 47	73.5	21	23.5	13	29	—	73	100	—	—
<i>I. torosus</i> , Little Mul- grave, 1939, W. G. H.	52.5	92	19	26	16	34	34	64	100	30 x 15	—
" "	52.5	79	19	23.5	13	34	34	73	108	—	—
" "	55	89.5	21	21	12	31.5	31.5	17	102	—	—
Rats, Cairns, 1939, W. G. H.	- 60	81.5	21	23.5	13	31.5	—	73	113	—	—
Mean	- 57.5	77.5	20	23.5	13	29	32	72.5	96	30 x 15	—



1, *Guntherana bipygalis* (Gunther) n. comb.; 2, *Paraschöngastia dubia* (Gunther); 3, *P. backhousei* (Gunther); 4, *P. gallinarum* (Kaw. and Yam.); 5, *P. yeomansi* (Gunther); 6, *P. retrocineta* (Gunther).

The DS range from 75 to 105 long, as follows: row 1 (scapula) 105, row 5 100, rest 75-80; arrangement, 2.6.4.6.2.

N.B.—The fig. 1, pl. xi, is drawn to scale from the data of the Bulolo specimens and not from the mean of all specimens measured.

Gunther gives the following: scutal width 81, length 33, SB 21, AM 28, AL 63, PL 83, and the DS are 2.6(2 or 4).4.2.4.2.6.2. We read his rows 4 and 5 as one row only and ignore the six small setae on the posterior dorsal plate, as well as his last row of two which are strictly ventral in position. In some specimens, notably those from Little Mulgrave, and some from Cairns, the posterior plate is entire and not longitudinally divided; there appear to be no other differences and the separation into two may only be a matter of development.

Genus WALCHIA Ewing 1931

Proc., U.S. Nat. Mus., 80, (8), 10. Genotype *Trombicula glabrum* Walch.

Palpi rounded laterally; palpal claw trifurcate; chelicerae each with a short chela. Dorsal plate present, as long as broad; bearing only four setae, exclusive of the pseudostigmatic organs, these setae being a pair of antero-laterals and a pair of postero-laterals. Pseudostigmatic organs clavate and setulate; eyes either lacking or represented by vestiges of a single pair. Dorsal abdominal setae moderate in size and number, less than 50 present. Legs moderate; second pair shortest; last pair longest.

Ewing laid stress generically on there being only four scutal setae besides the sensillary setae, the AM seta being wanting. Similarly in the genus *Gahrleipia* discussed by Gater (1932) and Gunther (1940) the dorsal scutum lacks the AM seta, but has a variable number of normal setae from four upwards. The minimum number of four is present in the species *G. rivi* Gunther from North Borneo, but here the scutum is posteriorly produced as a broad tongue-like process, so that the scutum is much longer than broad. In all the other species of *Gahrleipia* with produced scuta we find extra setae which are taken in from the dorsal rows by the posterior prolongation of the scutum.

KEY TO THE MALAYAN AND NEW GUINEA SPECIES OF WALCHIA

- | | | |
|---|--|---|
| 1 | Coxae III unisetose. | 2 |
| | Coxae III multisetose. | 4 |
| 2 | Dorsal scutum indistinct. AW, PW and SB equal, 25-26. <i>W. morobensis</i> Gunther 1939 | |
| | Dorsal scutum distinct. AW, PW and SB not all equal. | 3 |
| 3 | AW not much less than PW. ASB/SD about one-third, A-P/SD greater than half. DS 2.6.8.8.6.2.4.4.2. <i>W. rustica</i> (Gater 1932) | |
| | AW distinctly less than PW. ASB/SD about one-quarter A-P/SD = half DS 2.6.6.6.6.6.4.2. <i>W. turmalis</i> (Gater 1932) | |
| 4 | Coxae III with six setae. AW 17. Depth of posterior angle of scutum about half AW. Sensillae globose capitate. Dorsal setae 2.6.6.6.6.2.2. <i>W. lewethwaiti</i> Gater 1932 | |
| | Coxae III with less than six setae. AW greater than 25. | 5 |
| 5 | Coxae III with four setae. AW ca. 28. Depth of posterior angle of scutum about equal to AW. Sensillae globose capitate. DS 2.8.6.6.6.4.4.2. <i>W. nodis</i> Gater 1932 | |
| | Coxae III with only three setae. AW 31. Depth of posterior angle of scutum about two-thirds AW. Sensillae broadly clavate with prominent setules. DS 2.6.6.6.6.4.2. <i>W. glabrum</i> Walch 1927
= <i>pingue</i> Gater 1932 | |

WALCHIA GLABRUM (Walch 1927)

Trombicula glabrum Walch 1927, Genesk. Tijdsch. v. Ned. Indie, 67, (6), 926.
Walchia glabrum Ewing 1931, Proc. N.S. Nat. Mus., 80, (8), 10; *pingue* Gater 1932. Parasitology, 24.

(Pl. xii, fig. 1)

Of this species, described by Walch from rats from the Lampon District of Macassar, we have been able to identify three specimens from the Federated Malay States taken on *R. rattus argentiventer* Chasen, at Selinsing-Gunong, Semanggal, Perak, September 1932, and forwarded to us from the Institute of Medical Research, Federated Malay States. In addition, we have also examined a specimen (I.A.1.C. IV) from Batavia. All these specimens, as will be seen from the following standard data, agree well with Walch's description and figure. Gater's species was, unfortunately, described without figure but its synonymy with *glabrum* seems probable, the only differences are that Gater gives the sensillary setae as 21 long with the head "almost globular."

	AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
Perak.	- 31.5	48	26	21.5	33	35	25	30	28 x 11.5	25-32
"	- 31.5	48	28	21.5	35	38	23	29	28 x 11.5	25-32
"	- 30	48	23	20	35	35	25	31	28 x 11.5	25-32
Batavia	- 30	51	25	20	38	35	25	29	28 x 11.5	25-32
Mean	- 31	49	25.5	21	35	36	25	30	28 x 11.5	25-32

DS 2.6.6.6.4.2. Coxae III with three setae. One lateral claw obsolete.

Walch gives the following details: scutal width 49, SD 50, Sens. 29, DS 2.6.6.6.4.2, 34 long; and Gater's details are: scutal width 47, length 57, Sens. 21 capitate, almost globose, DS 8.6.2.6.4.4.2. (= 2.6.6.6.4.2). Coxae with three setae.

WALCHIA MOROBENSIS Gunther 1939

Walchia bulolocensis Gunther 1938, *nom. nud.*, Med. J. Aust., 2, (6), 202.

Walchia morobensis Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1-2), 94.

(Pl. xii, fig. 2)

We have been able to examine the type and three paratypes of this species and give the following standard data for two specimens:

	AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
Type	- - 25	25	25	16.5	16.5	33	20	31	25	—
Parat.	- - 25	26	27	17	—	34	18	30	25	—

Gunther gave: SB 25, AL 18, PL 30, Sens. 25.

WALCHIA LEWTHWAITEI Gater 1932

Parasitology 1932 24,

(Pl. xii, fig. 3)

We have been able to examine a specimen from the Institute of Medical Research, Kuala Lumpur, labelled as this species. It was from *R. rattus* (sub. sp.?) from Sungei Buloh, Selangor, 15 October 1940.

The standard data are:

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
17	31.5	17	17	21.5	28	11.5	15	—	—

DS 2.6.6.6.6.2.2. Gater's details are: scutal length 37, SB 18, Coxae III with six setae.

WALCHIA ENODIS Gater 1932

Parasitology 1932, 24.

(Pl. xii, fig. 4)

From the Institute of Medical Research, Kuala Lumpur we have received a specimen of this species collected from *R. mulleri validus* (Miller) from Sungei Buloh, Selangor, 8 August 1930.

The data for this specimen are:

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
28	50	23	21.5	38	35	20	26.5	—	—

DS 2.8.6.6.6.4.4.2.

Gater gives length of scutum 63, width 53, SB 24, setae on coxae III 3-5. No dimensions of sensillae are given, but they are said to be capitate with setules.

WALCHIA TURMALIS (Gater 1932)

Gahrlicpia turmalis Gater 1932, Parasitology, 24.

(Pl. xii, fig. 5)

This species should be placed in this genus rather than in *Gahrlicpia*.

We have been able to examine two paratypes from the original hosts and locality.

Standard data:

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
40	56	35	18	58	40	25	30	—	—
40	50	34	18	52	38	25	30	—	—

DS 2.6.6.6.6.6.4.2.

Details given by Gater are: scutal length 77, width 56, SB 34. DS 40 in number, but no arrangement or figure given.

WALCHIA RUSTICA (Gater 1932)

Gahrlicpia rustica Gater 1932, Parasitology, 24.

(Pl. xii, fig. 6)

As with the preceding species, this also should be placed in *Walchia*.

We have examined a paratype specimen with the following data:

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
40	46.5	30	17	39	33	28	25	—	—

Gater's data: scutal length 69, width 51, SB 30. Sen. figured but no dimensions given. DS 2.6.8.8.6.4.4.2.

GENUS GAHRLIEPIA Oudemans 1912

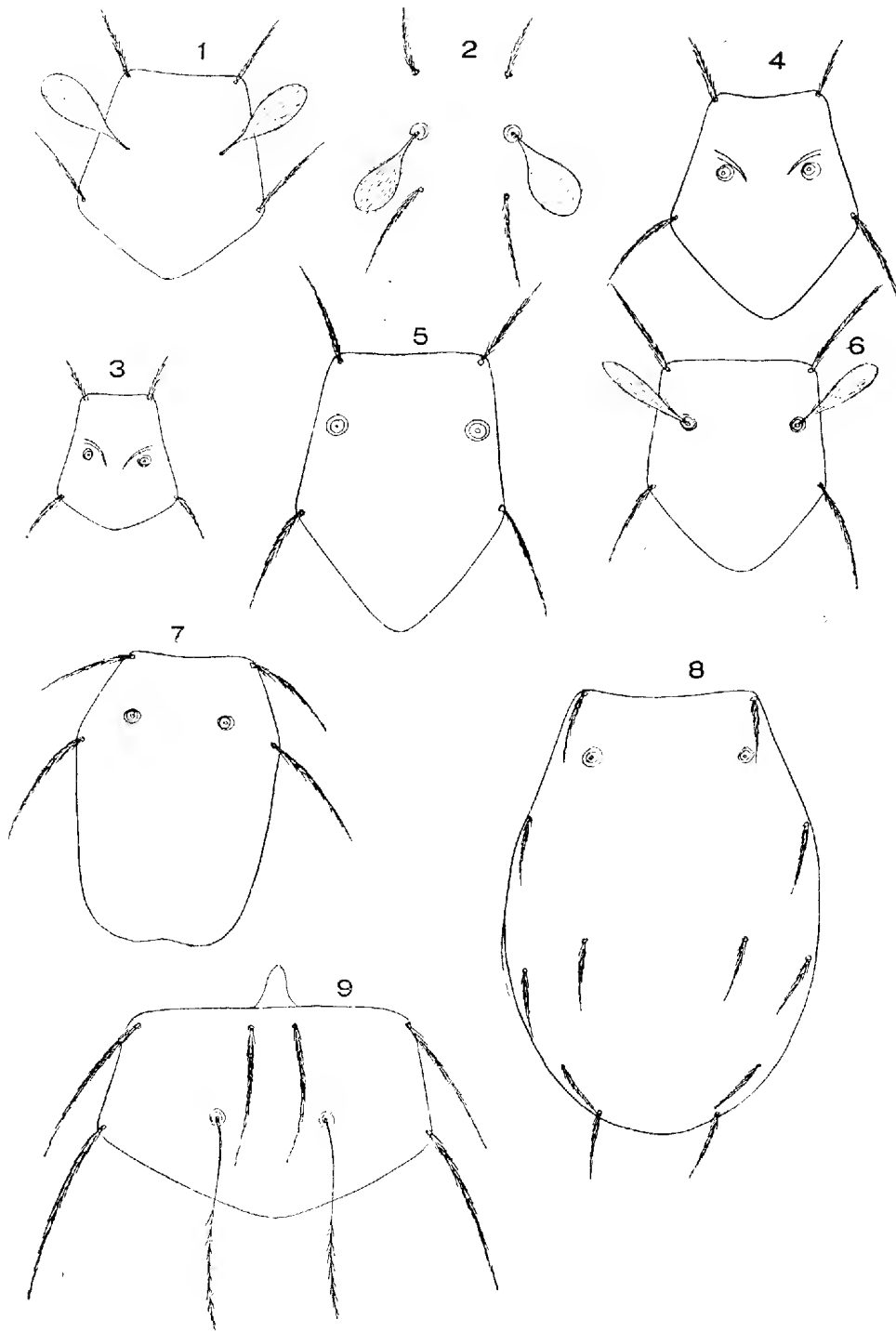
Typhlothrombium Oudemans 1910, Ent. Ber. Ned. Ent. Ver., 3, 102.

Gahrlicpia Oudemans 1912, Ent. Ber. Ned. Ent. Ver., 5, 237.

Schöngastiella Hirst 1915, Bull. Ent. Aes., 6, 183.

Gateria Ewing 1938, J. Wash. Acad. Sci., 28, (6), 295.

The genus *Typhlothrombium* was founded on the single species *T. nanus* Ouds. 1910, but as this generic name had been used by Berlese for an adult genus, Oudemans proposed *Gahrlicpia* in its stead (1912). In *nanus*, in addition to the sensillae, the scutum carries four pairs of ordinary setae. In 1915 S. Hirst erected the genus *Schöngastiella* for *S. bengalensis*, a species very close to *nanus* but with only three pairs of scutal setae besides the sensillae. Gater 1932 described six species from the Federated Malay States as belonging to *Gahrlicpia*, two, *turmalis* and *rustica* having only four normal scutal setae, the others, *rutilla*, *cetrata*, *ciliata* and *fletcheri*, having 10, 8, 14 and 20 normal scutal setae respectively. It has been shown earlier in this paper that in the formation of the dorsal scutum the species *turmalis* and *rustica* are more correctly placed in the genus *Walchia*. In 1940 Gunther described *Gahrlicpia rioi* from British North Borneo, also with only two pairs of normal scutal setae. In this respect it agrees with *Walchia* but must



1, *Walchia glabrum* (Walch); 2, *W. morobensis* (Gunther); 3, *W. lezethwaiti* Gater; 4, *W. enodis* Gater; 5, *W. inermis* (Gater); 6, *W. rustica* (Gater); 7, *Gahrleipia rioi* Gunther; 8, *G. rutila* Gater; 9, *Lecuzenhookia australiensis* Hirst.

be differentiated therefrom on the posterior tongue-like production of the scutum characteristic of *Gahrliopia*.

It follows, therefore, that in *Gahrliopia* we have species in which the normal scutal setae range from two pairs (which can be regarded as the normal or primitive number) through 3.4.5.7 to 10 pairs. In 1938 Ewing erected the genus *Gateria* (with *Gahrliopia fletcheri* Gater, as type) for those species in which some of the scutal setae were not marginal. In this genus would also be included *rutila* and *ciliata*.

However, if one carefully compares the scuta of the species of *Gahrliopia* it is seen that the posterior production of the scutum tends to take in a number of the median setae of one or more of the normal dorsal rows. At the beginning of this development we have *G. rioi* with the characteristic tongue-like extension but not yet embracing any extra setae; then through *bengalensis* with two extra, *nana* with four extra, and so on to *fletcheri* which takes in four extra median setae from the second dorsal row, eight from the third row, two from the fourth and two from the fifth row. In view of the transition the genus *Gateria* becomes unnecessary.

The setae of the dorsal rows taken in by the extension of the scutum are indicated by square brackets.

KEY TO THE INDIAN, MALAYAN AND NEW GUINEA SPECIES OF GAHRLIEPIA

- 1 With only four setae on dorsal scutum. Scutum small. SD 76. Sens. ?
G. rioi Gunther 1940
- 2 With more than four scutal setae.
- 2 With six scutal setae. SD 80. Sens. clavate. DS 2,4[2],8.8.6.4.2.2, *i.e.*, only the two medial setae of second dorsal row on scutum. *G. bengalensis* (Hirst)
- With eight scutal setae. SD 190. Sens. clavate. DS 2.6[2],6[2].6.6.4.4.2, *i.e.*, two medial setae of second and third dorsal rows are on the scutum. *G. cetrata* Gater 1932
- More setae on scutum.
- 3 Scutum with twelve setae. SD 117. Sens. ? DS 2.6[2],4[2].[2].6.4.4.4.2, *i.e.*, scutum embracing two medial setae of rows 2, 3 and 4. *G. rutila* Gater 1932
- Scutum with 14 setae. SD 189. Sens. ? DS 2[4].4[2].4[2].4[2].6.4.2.4.2, *i.e.*, scutum embracing all of second row, and medial two setae of third, fourth and fifth rows. *G. ciliata* Gater 1932
- Scutum with 20 setae SD 188. Sens. clavate. DS 2[4].10[8].4[2].6[2].6.8.4.2, *i.e.*, scutum embracing all second row, eight setae of third row, and two of fourth and fifth rows. *G. fletcheri* Gater 1932

GAHRLIEPIA RIOI Gunther 1940

Proc. Linn. Soc. N.S.W., 65, (5-6), 1940, 481.

(Pl. xii, fig. 7)

We have not seen any specimens of this species and have constructed the figure of the dorsal scutum and compiled the standard data from Gunther's details.

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
30	50	25	18	58	24	28	40	—	—

Arrangement of DS, 2.6.6.6.4.2.

GAHRLIEPIA RUTILA Gater 1932

Parasitology 1932, 24.

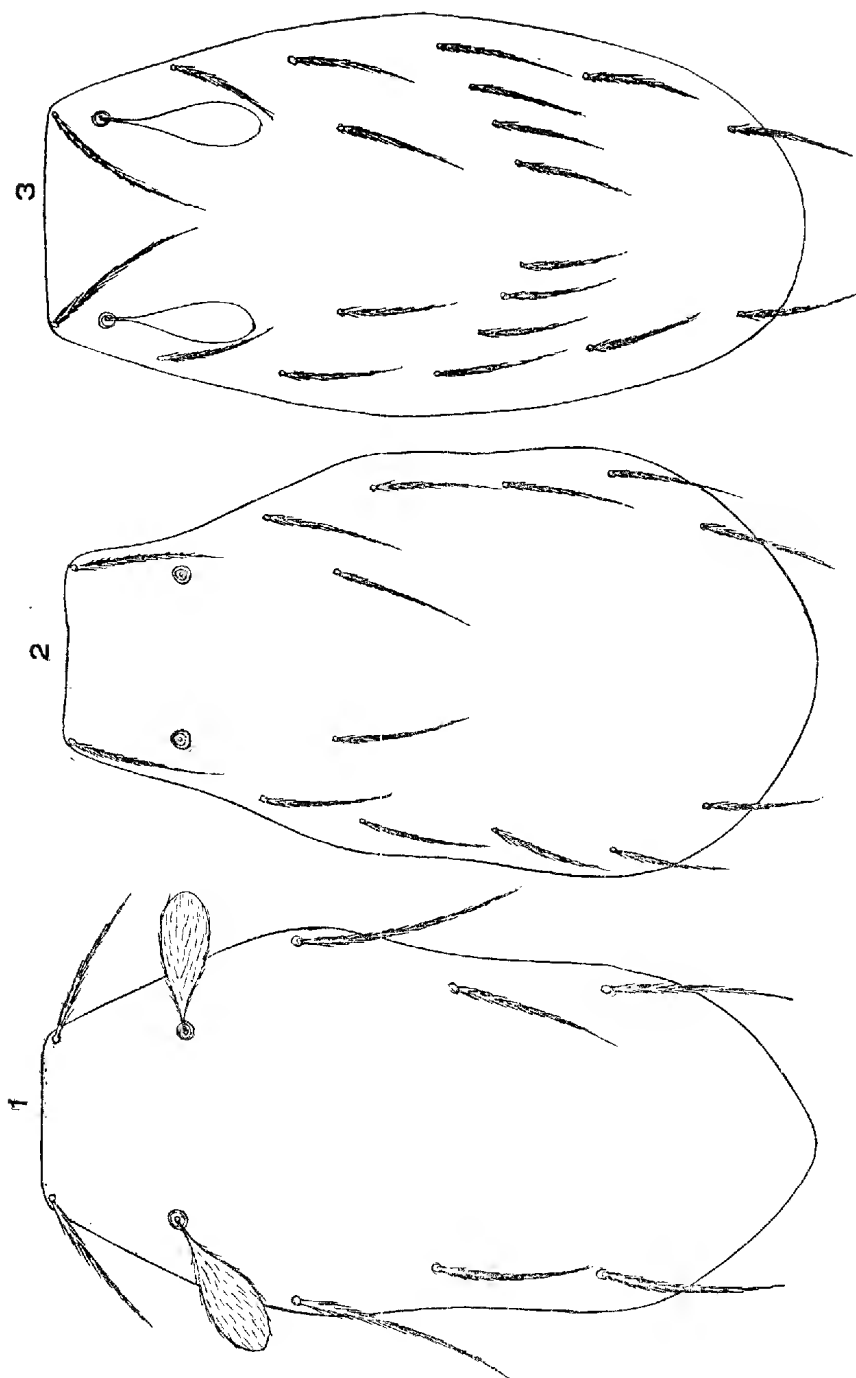
(Pl. xii, fig. 8)

We have examined a paratype, with the following data:

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
43	73	41.5	17	99.5	35	18	18	—	—

Maximum width of scutum, 83.

Arrangement of DS, 2.6[4].4[2].[2].6.4.4.4.2.



1, *Gahrleipia cetrata* Gater; 2, *G. ciliata* Gater; 3, *G. fletcheri* Gater.

GAHRLIEPIA CETRATA Gater 1932

Parasitology 1932, 24. (Pl. xiii, fig. 1)

As we have not seen any specimens of this species our standard data and figure of the dorsal scutum to scale are from Gater's details.

AW	PW	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
42	90	49	35	155	65	40	55	37	—

Arrangement of DS, 2.6[2].6[2].6.6.4.4.2.

GAHRLIEPIA CILIATA Gater 1932

Parasitology 1932, 24. (Pl. xiii, fig. 2)

From Gater's figure and data we get the standard data:

AW	PW	Max.W.	SB	ASB	PSB	A-P	AL	PL	Sens.	DS
40	70	109	42	30	159	53	45	38	—	—

DS 2.[4].4[2].4[2].4[2].6.4.2.4.2.

GAHRLIEPIA FLETCHERI Gater 1938

Parasitology 1932, 24.

= *Gateria fletcheri*, Ewing 1938. (Pl. xiii, fig. 3)

We have been able to examine a paratype of this species, of which the standard data are:

AW	PW	Max.W.	SB	ASB	PSB	A-P	AL	PL	Sens.
52	79	100	50	18	170	39	50	37	—

From Gater's figure and data we have:

AW	PW	Max.W.	SB	ASB	PSB	A-P	AL	PL	Sens.
54	73	99	50	15	173	31	50	35	30

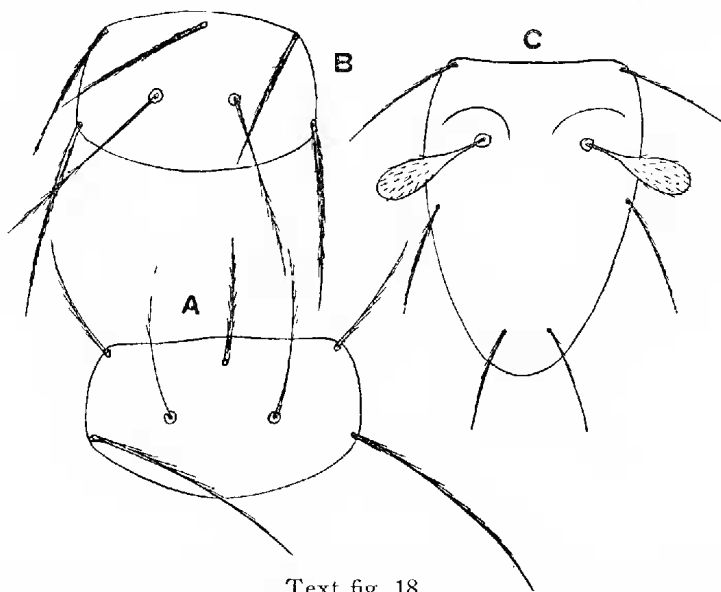
Arrangement of DS, 0.6[4].10[8].4[2].6[2].6.8.4.2.

GAHRLIEPIA BENGALENSIS (Hirst 1915)

Schöngastiella bengalensis Hirst 1915, Bull. Entom. Res., 6, 1915.*Gateria bengalensis*, Ewing, 1938, J. Wash. Acad. Sci., 28, (6), 295.

(Text fig. 18, C)

This species was originally described from the ears of *Mus rattus* from Calcutta, India.



Text fig. 18

Dorsal scuta. A, *Trombicula cervinicola* Ewing, x 500; B, *Trombicula isschikii* Sugimoto, x 500; C, *Gahrliopia bengalensis* (Hirst), x 500.

Unfortunately, the only dimensions given were the scutal length 80, width 56. From these and the figures given by Hirst, the following standard data have been compiled:

AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
40	80	25	22	58	36	—	30	30	30	30

DS arranged, 2.4[2].8.8.6.4.2.2., *i.e.*, the median two setae of second row of dorsal setae taken in by the posterior extension of the scutum.

Genus LEEUWENHOEKIA Oudms. 1911

Entom. Ber., 3, (5-8), 137. Genotype *Heterothrombium verduni* Oudms. 1910. Characterised as in the key to genera.

LEEUWENHOEKIA AUSTRALIENSIS Hirst 1925

Trans. Roy. Trop. Med., 19, 1925, 150-152.

(Pl. xii, fig. 9)

This species was originally recorded from human beings in New South Wales. I have also recorded it from Glen Osmond, South Australia, and Gunther records it from New Guinea, and W. G. Heaslip has taken it plentifully at Cairns and Brisbane, Queensland.

We give the following standard data for a number of specimens from various localities:

Lco.	AW	PW	SB	ASB	PSB	A-P	AM	AL	PL	Sens.	DS
Cairns, Q.	68	80	26.5	29	25	26.5	36.5	41.5	55	50	45
"	69	81.5	28	29	25	29	36.5	41.5	50	50	45
"	71	91	25	29	26.5	29	41.5	46.5	55	—	50
"	76	91	26.5	33	29	33	46	46.5	55	—	46
"	70	92	29	29	25	33	36.5	41.5	51	50	45
"	79	91	29	33	29	31	43	49	66	53	42
"	64	—	—	—	—	—	41.5	—	—	—	48
"	64	88	33	30	26.5	29	41.5	41.5	50	—	45
Glen Osmond, S.A.	70	91	30	34	26.5	33	41.5	41.5	58	55	45
"	75	91	28	33	29	33	38	—	55	50	45
Cairns, Q.	73	91	29	35	29	29	46	46	53	66	48
"	71	85	26.5	29	25	28	41.5	50	61.5	—	45
Brisbane, Q.	74	94.5	33	33	25	33	41.5	41.5	58	52	45
Bulola, N.G.	75	91.5	29	33	29	29	50	52	64	58	55
Mean	72	89	29	31	27	30	42	44	56	54	45-55

DS 2.6.6.8.10.8.6.4.2.

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